PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

Edited and Issued Monthly by

THE INSTITUTION OF ELECTRICAL ENGINEERS

In Association with

THE PHYSICAL SOCIETY

THE AMERICAN PHYSICAL SOCIETY

THE AMERICAN
INSTITUTE OF ELECTRICAL ENGINEERS

ABSTRACTS 210–486

LUME 51 **FEBRUARY 1948** NUMBER 602

PRINCIPAL CONTENTS

February 1948

		PAGE
51	**MATHEMATICS**	25
52	**ASTRONOMY. ASTROPHYSICS. GEODESY**	25
53	**PHYSICS**	25
530.1	**Fundamentals**	25
530.145	Quantum theory	26
531	**General mechanics. Mechanics of solids**	26
531.7	**Mechanical measurements**	27
531.787	Manometers	27
532	**Mechanics of liquids**	27
532.6	**Capillarity**	28
532.7	**Kinetic theory of liquids**	28
533	**Mechanics of gases**	28
533.7	**Kinetic theory of gases** — No abstracts	
534	**Vibrations. Acoustics**	29
534.232	Acoustic radiators	29
535	**Optics. Radiation. Spectra**	30
535.24	Photometry	30
535.33/.34	Spectra	31
535.34	Absorption	31
535.37	Luminescence	32
535.39	Optical films	32
535.4	Interference. Diffraction	33
536	**Heat**	34
536.2	Conduction. Heat transfer	34
536.42	Change of state	34
536.48	Low temperature phenomena	35
536.7/.8	**Thermodynamics**	35
537	**Electricity**	35
537.226	Dielectrics	35
537.3	**Electric currents**	36
537.5	**Electric discharges and radiations**	36
537.531	X-rays	37
537.533	Cathode rays	37
537.534	Positive rays	38
537.542	Discharge tubes. Counters	38
537.56	Ionization. Ions	39
537.591	**Cosmic rays**	39
538	**Magnetism**	40
538.3/.5	**Electromagnetism. Electrodynamics**	40
538.6	**Magnetic effects**	41
539	**Atomic and molecular structure**	41
539.152.1	Nucleus	42
539.16/.18	**Radioactivity. Nuclear disintegration. Nuclear particles**	43
539.17	Artificial disintegration	44
539.172	Nuclear transmutation	44
539.18	Neutrons. Mesons	45
539.2	**Structure of solids**	46
539.3/.8	**Elasticity. Strength. Rheology**	46
541	**PHYSICAL CHEMISTRY**	47
541.121/.123	**Phase equilibrium**	47
541.124/.128	**Reaction kinetics**	47
541.13	**Electrochemistry**	48
541.14	**Photochemistry**	48
541.18/.182	**Colloids. Disperse systems**	48
541.183	**Adsorption**	48
541.4/.6	**Chemical structure**	48
543/545	**Chemical analysis**	49
548	**CRYSTALLOGRAPHY**	49
549	**Mineralogy**	50
55	**GEOPHYSICS**	50
551.5	**Atmosphere. Meteorology**	50
57/59	**BIOLOGY**	52
61	**Medical science. Human physiology**	52
669	**Metallurgy**	52

The headings printed in bold type will be found in the text. The others may be located by their U.D.C. number.

RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

Mechanical testing
Non-destructive testing
Industrial radiography
Corrosion
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers, which are printed at the head of the Abstract on the left. Abstracts on any particular subject can be located by first consulting the abridged tables of the U.D.C. published with the January number, or the Annual Alphabetical Subject Index, and then referring to the appropriate U.D.C. number in the text. The main headings are listed above.

An Abstract of interest under more than one head has additional U.D.C. numbers, linked by the colon sign, ":" e.g. "536.21 : 548.0 Conduction of heat in crystals." The Abstract is printed once only, under the main number, e.g. in the section "HEAT 536," but Cross-references are inserted under the other numbers, e.g. "548.0 : 536.21 *see Abstr.* 1234" in the section "CRYSTALLOGRAPHY 548." These Cross-references should be investigated, therefore, when a particular section is being searched, as they contain additional matter relevant to that section. A Cross-reference does *not* refer to the Abstract which appears immediately above it.

[*Continued on page 3 of cover*]

MATHEMATICS 51

210
ote on a problem of Mahler. ROGERS, C. A. *Proc. Soc. A*, **191**, 503–17 (*Dec.*, 1947).—See Abstr. 504

211
method of the hypercircle in function-space of ary-value problems. SYNGE, J. L. *Proc. Roy. 4*, **191**, 447–67 (*Dec.*, 1947).

212
Bernoullian Fourier diagrams. WINTNER, A. *Mag*,. **38**, 495–504 (*July*, 1947).

213
(C, 1)-convergent integrals and their application to matical physics. GHOSH, P. K. *Bull. Calcutta . Soc.*, **39**, 19–29 (*March*, 1947).—A theory of e integrals which oscillate in the ordinary sense is oped. These are used to solve certain differential ions and the physical applications consist of utherford scattering, treated by the Born approximation, and (2) Bethe's investigation of the passage of fast particles through matter [Abstr. 3811 (1930)]. L. S. G.

518.2 : 535.436 : 551.521.3 *see Abstr.* 472

518.5 : 621.317.35 = 85 214
Analysis of empirical curves. TRNKA, Z. *Elektrotech. Obz.*, **35**, 221–8 (*Aug.*, 1946) *In Czech.*—[Abstr. 270 B (1948)].

518.6 : 531.225 *see Abstr.* 235

519.2 215
A problem on the summation of simple harmonic functions of the same amplitude and frequency, but of random phase, and the probability distributions of sinusoidal oscillations combined in random phase. SLACK, M. *Phil. Mag.*, **38**, 297–8 (*April*, 1947).—See Abstr. 511 (1947).

519.271.01 216
The accumulation of chance effects and the Gaussian frequency distribution. PARKER, J. B. *Phil. Mag.*, **38**, 681–2 (*Sept.*, 1947).—The problem of a previous paper [Abstr. 75 (1945)] is treated more simply. L. S. G.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

= 4 217
possibility of projectiles from points on the earth aining satellites of the earth. ESCLANGON, E. *C.R. . Sci., Paris*, **225**, 161–3 (*July* 21, 1947) *In French.*—iders a suggestion that projectiles might be launched sufficient speed to become permanent satellites of the . The author shows that if the atmosphere is ed this is never possible. If the resistance of the air en into account, perigee distance must $\leqslant$ the earth's s; the projectile must therefore return to the ground. shape of the earth is not far enough from spherical to this. Only if the projectile has a special shape to use of the resistance of the air, or if it is for a time ropelled, is satellite formation possible. T. L. M.

= 4 218
nversion of projectiles from the ground into per- nt satellites of the earth. ESCLANGON, E. *C.R. . Sci., Paris*, **225**, 513–15 (*Sept.* 29, 1947) *In French.*—author considers conditions under which a projectile, sufficient velocity to go beyond the limits of the tive resisting atmosphere, might be converted into a satellite of the earth (*a*) by a means of propulsion ating after passing the limits of the air and timed to cease when the orbit is wholly beyond those limits, or (*b*) by a timed explosion producing fragments which fulfil these conditions. Limits of velocity and direction of motion are found and shown to be narrow if the artificial satellite is to be near the earth. T. L. M.

523.2 219
The cosmogonic significance of the position of the ecliptic plane in the galaxy. SCHMIDT, O. J. *C.R. Acad. Sci., URSS*, **52** (*No.* 7) 577–80 (1946).—The position of the ecliptic plane is of significance in the author's theory of the origin of the earth and the planets. According to this the sun at one time crossed a cloud of meteoric matter, part of which was captured and began to revolve around the sun. On this theory the planes of the planet orbits and the plane of the sun's equator should all intersect almost along a single straight line lying in the galactic plane. Evidence for this is deduced from certain experimental facts. L. S. G.

523.671 = 4 220
Spectrum of the nucleus of the Whipple–Fedtke comet (1942 g). DUFAY, J., AND TCHENG, M.-L. *Cah. de Phys.* (*No.* 27) 39–49 (*June*, 1945) *In French.*

PHYSICS 53

g 221
me aspects of instrumental physics in France (1939–). BOUTRY, G. A. *J. Sci. Instrum.*, **24**, 281–95 ., 1947).—The various instruments described include following (28 references given): "Optical ruler"; hanical calculating machine for division; electro- stic elasticimeter; recording manometer; optical grator; "apodization" (suppression of diffraction ges surrounding images); microscope objectives; trographs and monochromators; organic glass; trostatic generators; X-ray apparatus; cloud chamber es; G.M. counters; electron microscopes.

081.1 : 621.3.081.1 = 3 222
hysical quantities. A clarification of concepts. BERLI, F. *Schweiz. Arch. angew. Wiss. Tech.*, **13**, 70 (*March*); 113–19 (*April*, 1947) *In German.*—Basic principles are compared and a scheme of comparison for the various systems of units is developed. Further discussion is given of the M.K.S. system. A.

53.087.6 : 531.787 *see Abstr.* 244

FUNDAMENTALS 530.1

530.12 223
The invariants of kinematical relativity. WALKER, A. G. *Phil. Mag.*, **38**, 316–24 (*May*, 1947).—The advantage of the tensor calculus in the formation and study of the invariants is demonstrated. A comparison is made with the work of others [Abstr. 2735, 2736 (1945)]. L. S. G.

530.12 224
Historical note on the rate of a moving atomic clock. IVES, H. E. *J. Opt. Soc. Amer.*, **37**, 810–13 (*Oct.*, 1947).

530.14 = 4 225

A new formulation of the relations between the 16 bilinear forms derived from the Dirac matrices. DURAND, É. *C.R. Acad. Sci., Paris*, **225**, 280–2 (*Aug.* 4, 1947) *In French.*

530.14 = 4 226

On the relativistic symmetry of the quantum formalism in the theory of Dirac. DE BEAUREGARD, O. C. *C.R. Acad. Sci., Paris*, **225**, 626–9 (*Oct.* 13, 1947) *In French.*

530.14 : 539.152.1 : 537.133 227

Proton isobars in the theory of radiation damping. HEITLER, W., AND HU, N. *Proc. R. Irish Acad.*, **51 A** (*No.* 9) 123–40 (*May*, 1947).—The limitations of the Heitler radiation damping theory prevent its direct application to static problems and hence its use to find the bound states of a nucleon + meson field. By this theory, however, the scattering, or *S*-, matrix can be obtained, and the condition $S = 0$ gives the energies required. For a mixed vector-pseudoscalar theory, with various total charges for the system, only a few states are obtained with excitation energies of $\sim$ 20 MV for coupling constants (f, g) deduced from the deuteron. The energies $\propto f^2$ and g^2. G. J. K.

530.145 : 535.14 228

Radiation damping theory and the propagation of light. FERRETTI, B., AND PEIERLS, R. E. *Nature, Lond.*, **160**, 531–2 (*Oct.* 18, 1947).—Two forms of Heitler's theory are distinguished, the "time-dependent" and the "stationary." In the former, "roundabout transitions" (those with $>$ the least possible number of steps) are omitted from the equations describing any two given energy states. It is shown that this may lead to ambiguity in the case of a transfer of a photon of energy $h\nu_0$ between two atoms distance r apart, and does not give the reasonable result that the probability of the second one becoming excited is zero until time r/c, and > 0 thereafter. The stationary theory cannot treat the problem of light propagation, as it only gives asymptotic results valid in the limit of very long times.

530.145 : 538.3 : 539.15 229

Quantum electrodynamics and the interaction of the hydrogen-like atoms with a radiation field. ELIEZER, C. J. *Bull. Calcutta Math. Soc.*, **38**, 145–50 (*Dec.*, 1946).—The wave equation is solved. When the radiation interaction is taken as a perturbation, the wave function is free from divergent integrals, to any order of approximation, provided (1) the λ-limiting process is used together with negative energy photons, and (2) the solution corresponding to outgoing waves is taken. Radiation damping does not cause displacement of spectrum lines, nor does it influence other radiative processes, e.g. photoelectric effect or bremsstrahlung. [See Abstr. 203–4 (1947)].

L. S. G.

530.145.6 230

Recurrence formulas for Coulomb wave function. INFELD, L. *Phys. Rev.*, **72**, 1125 (*Dec.* 1, 1947).—It is pointed out that these formulae given by Powell [*Phys. Rev.*, **72**, 626 (1947)] were derived by the author [Abstr. 1445 (1941)] as particular cases of the factorization method. W. E. D.

530.145.6 : 537.533.74 *see Abstr.* 350

530.162 : 539.15 = 4 231

The formation of images in particle optics. DE BROGLIE, L. *Rev. Opt.* (*Théor. Instrum.*) **26**, 397–410 (*Nov.*, 1947) *In French.*—A theoretical survey in two parts, the first consisting of a résumé of the general theory of image formation in optics, while the second gives a more detailed study of resolving power in terms of the uncertainty principle. The uncertainty principle implies that t diffraction of each incident particle by the object accompanied by motion of the object. It is simple calculate the limit of resolution in the case of free ato and the value turns out to be about 1 000 Å. In the c of bound atoms, when it is desired to obtain a resolv power $\simeq 0{\cdot}1$ Å, the necessary primary energy is gr enough to remove the outer shell electrons. It is the fore concluded that fundamental quantum conditio preclude the possibility of visual study of atomic struct by known means. A. H. W.

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.19 : 532.7 : 536.48 *see Abstr.* 318

531.224

On the bending of an initially straight beam un arbitrary loading. GILLIES, A. W. *Phil. Mag.*, **37**, 813 (*Dec.*, 1946).—The general solution for the bending obtained in a form convenient for application. T special examples discussed include: (*a*) single concentra load on a beam with built-in ends, (*b*) simply suppor beam bent by a couple at a point on its length. L. S.

531.224

Bending of clamped rectilinear plates. SETH, B. *Phil. Mag.*, **38**, 292–7 (*April*, 1947).—Expressions obtained for the central deflection and for the maxim flexural couple. L. S.

531.224.7 : 531.787.2

A note on the theory of corrugated diaphragms pressure-measuring instruments. PFEIFFER, A. *Rev. Instrum.*, **18**, 660–4 (*Sept.*, 1947).—A hypothetical mo for the distribution of stress in diaphragms is discuss It is constructed of members in series, with each c sisting of one flexural and one tension spring acting parallel. This hypothetical model lends to a correlati between pressure P acting on the diaphragm, correspo ing deflection of the diaphragm h, effective diameter sheet thickness d, and "plate modulus" F, as a meas of elasticity, of the following form:

$$Fh/2Pr = \sum_{k=1}^{k=n} [c_{k1}(d/2r) + c_{k2}(d/2r)^3]^{-1}$$

where the quotients Fh/Pr and $d/2r$ each are fact without dimensions.

531.225 : 518.6

Punch-card machine methods applied to the solution the torsion problem. BERGMAN, S. *Quart. Appl. Ma* **5**, 69–81 (*April*, 1947).—Orthogonal functions toget with punch-card machines are used to solve Laplac equation arising in the torsion problem for a bar uniform cross-section. L. S.

531.234 : 531.252

The theorem of four moments, with applications in theory of plane structures. TURTON, F. J. *Phil. Mag.*, 251–67 (*April*, 1947).—The theorem is proved and appl to some redundant frames and to the determination secondary stresses. L. S.

531.252 : 531.234 *see Abstr.* 236

531.258

The boundary-value problems of plane stress. I. LIVE G. H., AND MORRIS, R. M. *Phil. Mag.*, **38**, 153– (*March*, 1947).—A new treatment of two-dimensio potential theory is given. It is important in that a p viously developed method is combined with a modificati of the approach of Stevenson [Abstr. 567 (1946), (1944)] and Green [Abstr. 990 (1946), 2151 (194

739 (1940)], and this leads to all known results and siderable extension. Included are all those problems may be solved without the use of multivalued ntials. The solutions given by Green are invalid the stresses they represent become ∞ at a number olated points. A method for avoiding this difficulty en. The effect of an elliptic hole on a specified stress bution is studied in detail. L. S. G.

59.2 238

resses near the end of a long cylindrical shaft under uniform pressure loading. TRANTER, C. J., AND GGS, J. W. *Phil. Mag.*, **38**, 214–25 (*March*, 1947).

9 : 621.396.67 : 621.396.9 239

problem in dynamic balancing of scanners for radar. C. *Phil. Mag.*, **37**, 830–42 (*Dec.*, 1946).—A descrip- is given of scanning apparatus, which projects a radio in a repeating spiral. The conditions of balancing e system are investigated and a general method of ncing is determined. The treatment is mathematical the practical applications are described. L. S. G.

45 240

n the rolling of a cylinder over a surface covered with cous layer. SLEZKIN, N. A. *C.R. Acad. Sci. URSS*, *No.* 7) 573–6 (1946).—A circular cylinder of given th, radius and weight rolls on a horizontal plane ered with a material of given viscosity. A formula the tractive force is found and an expression for the ficient of rolling friction is obtained. L. S. G.

553 : 533.6.011.5 *see Abstr.* 260

MECHANICAL MEASUREMENTS 531.7

.715.27 241

new method for the measurement of the mean diameter fibres in a bundle. GIOVANELLI, R. G. *J. Sci. Instrum.*, 314–17 (*Dec.*, 1947).—The method consists, first, of ermining the projected area of a bundle of fibres, in trary units, by means of the light deflected from a to-electric cell by the fibres when they are placed in an dent beam. The bundle of fibres is then weighed and, er ideal conditions, the ratio of the mass to the light ciency ∝ the dia. The method requires the density he fibres to be constant and applies only to nearly ular fibres for which the coefficient of variation is not great. An instrument has been made using this hod. Results are compared with projection micro- pe measurements, using wool fibres. Errors are cussed. A.

.717 : 535.39 : 535.417 *see Abstr.* 304

.717.1 : 621.385.8 : 621.317.39 242

eta-ray thickness gage for sheet steel. SMITH, O. J. M. *ctronics*, **20**, 106–12 (*Oct.*, 1947).—[Abstr. 280 B 48)].

.781 243

A gauge for measuring compression force. RINKEL, H. *J. Sci. Instrum.*, **24**, 298–9 (*Nov.*, 1947).—A test dy is placed, together with the gauge, in a press or vice d subjected to compressing force. The amount of ce is shown on the gauge during the test, and can be usted or varied as desired. The construction is scribed, and data are given for the design of gauges for y other range as may be required. A.

1.787 : 53.087.6 244

Distortion in manometer and oscillograph records. OMAS, T. S. E. *Phil. Mag.*, **38**, 361–8 (*May*, 1947).— e theory of the instruments is briefly discussed together th the errors in the recording of transient pulses. The effect of frequency and damping in the recording of the transient Kte^{-t} is shown graphically. L. S. G.

531.787.2 : 531.224.7 *see Abstr.* 234

531.787.6 245

A direct-reading differential micromanometer. HINDLEY, H. R. *J. Sci. Instrum.*, **24**, 295–6 (*Nov.*, 1947).—A differential manometer is described having a sensitivity better than 2×10^{-4} mm of Hg. Two bells with their mouths below a liquid surface are suspended from the beam of a torsion balance. The pressures are communicated to the interiors of the bells and tilt the balance beam. Results are read on an illuminated scale without manipulation of the instrument. The response is rapid and accurate levelling is not required. A.

MECHANICS OF LIQUIDS 532

532.13 : 536.22 : 532.7 246

The effect of temperature on the thermal conductivity and viscosity of liquids. EISENSCHITZ, R. *Proc. Phys. Soc., Lond.*, **59**, 1030–9 (*Nov.*, 1947).—The theory of Brownian movement is applied to the "cell model" of liquids. The Smoluchowski equation for the density distribution is solved under conditions corresponding to laminar flow and conditions corresponding to inhomogeneous temperature. The flow of momentum and the flow of energy are calculated. The result indicates that the viscosity ∝ exp $(1/T)$ and that the thermal conductivity ∝ T. A.

532.137 247

The measurement of the viscosity of glycerol at high temperatures. VAND, V. *Research, Lond.*, **1**, 44–5 (*Oct.*, 1947).—Viscosity of two samples of glycerol was measured from 80–167°C. The measurements were corrected for the moisture content and an empirical formula derived which is in good agreement with the measurements. A.

532.51 : 538.12 : 537.212 *see Abstr.* 323

532.513.032 : 533.6.01 *see Abstr.* 258

532.517.4 : 535.551 248

A study by a double-refraction method of the development of turbulence in a long circular tube. BINNIE, A. M., AND FOWLER, J. S. *Proc. Roy. Soc. A*, **192**, 32–44 (*Dec.* 23, 1947).—The flow in a long glass tube of a very weak solution of benzopurpurin water was examined. Two kinds of turbulent entry were used: with one, laminar flow at a Reynolds number of ~ 1 900 was observed at cross-sections > 120 dia. from the entry; with the other the corresponding distance was 90 dia. The nature of the breakdown of laminar flow at a cross-section was found to depend upon the kind of entry and upon the distance of the cross-section from the inlet. The development of complete turbulence at various cross-sections was also investigated. A.

532.528 : 534.23 249

Properties of liquids at high sound pressure. BRIGGS, H. B., JOHNSON, J. B., AND MASON, W. P. *J. Acoust. Soc. Amer.*, **19**, 664–77 (*July*, 1947).—Under steady-state conditions, light liquids filled with air cavitate when the negative acoustic pressure reaches the atmospheric pressure. When degassed, their natural cohesive pressure becomes effective and they will withstand a negative acoustic pressure up to a value equal to the sum of the cohesive pressure—tensile strength—and the ambient pressure. Viscous liquids have a higher cohesive pressure and a proportionality has been established between log (viscosity) and the cohesive pressure. The amount of power that a liquid can withstand increases markedly as the pulse length is shortened. An explanation of these phenomena is attempted on the basis of Eyring's theory

of viscosity, plasticity and diffusion. On this theory natural holes exist in the liquid into which molecules can jump, leaving holes behind them. A jump occurs when the molecule has accumulated enough heat energy to surmount an activation potential barrier of energy value E_0. Cavitation appears to be the result of coalescing of the natural holes in the negative pressure phase of the cycle. Since a molecule has to jump from a hole in order that this can coalesce with another hole, the cavitation pressure $\propto$ the activation energy which in turn $\propto$ (viscosity). The increased power-transmitting capacity for short pulse lengths is a result of the finite time taken for the small holes to grow in size to a large enough hole to cause rupture of the liquid. A.

CAPILLARITY 532.6

532.612.4 : 532.696.1 : 541.183.1 250

Surface tension and detergency. ADDISON, C. C. *Nature, Lond.*, **160,** 467 (*Oct.* 4, 1947).—It is pointed out that disequilibrium of a surface film caused by expansion or contraction is only repaired after a certain length of time. Thus the effect of changes of area must be considered, in addition to concentration and ageing time, for the surface tension of a solution.

532.64 : 539.23 251

Surface studies of glass. I. Contact angles. SPITZE, L. A., AND RICHARDS, D. O. *J. Appl. Phys.*, **18,** 904–11 (*Oct.*, 1947).—The water-repellent nature of glass surfaces treated with different silicones is examined by means of contact-angle measurements. Results are given showing the effect of various concentrations of silicones, types of glass, temperature of heat treatment, length of time of heat treatment, and surface roughness on the water contact angles. Silicones containing the methyl and phenyl group show good heat stability at temperatures of 500°C for short periods of time. A.

532.696.1 : 541.183.1 : 532.612.4 *see Abstr.* 250

KINETIC THEORY OF LIQUIDS 532.7

532.7 : 531.19 : 536.48 *see Abstr.* 318

532.7 : 536.22 : 532.13 *see Abstr.* 246

532.7 : 536.48 252

The theory of liquid helium. TISZA, L. *Phys. Rev.*, **72,** 838–54 (*Nov.* 1, 1947).—A quasi-thermodynamic theory is developed based on very general assumptions regarding the energy spectrum of the liquid. Below the λ-point He can be considered as a mixture of two fluids capable of two velocity fields. The macroscopic hydrodynamic equations of this system are derived. These are in the same relation to ordinary hydrodynamics as a two-body is to a one-body problem in point mechanics. The flow connected with the centre-of-mass co-ordinate is associated with the transport of mass at constant entropy, the one connected with the relative co-ordinate (internal convection) is associated with an entropy transport at constant density. The results are in excellent agreement with experiment, in particular with the measurements of the temperature waves (second sound), the existence of which was predicted by the theory. The Bose–Einstein liquid introduced earlier is a possible molecular model consistent with the macroscopic results. Landau's theory is discussed. A.

532.7 : 539.13 *see Abstr.* 377

532.72 : 541.132 *see Abstr.* 440

532.72.08 : 535.417 *see Abstr.* 303

532.74 25

A formula to detect association in liquids. PARSHAD, H *J. Chem. Phys.*, **15,** 761–2 (*Oct.*, 1947).

MECHANICS OF GASES 533

533.15 : 536.48 25

Some measurements on thermomolecular pressure ratio in hydrogen and in neon. KEESOM, W. H., AND SCHWEER J. *Commun. K. Onnes Lab. Leiden* (*No. 264a*). *Physic 's Grav.*, **8,** 676–86 (*July*, 1941).—The authors measure the thermomolecular pressure ratios for H and Ne the ends of a capillary, 0·0728 cm wide, the temp. at or end being 77°K, at the other end 14–20°K, in the pressu range from 0–20 μb. The results deviate somewhat fro Weber and Schmidt's formula, which was principall based on measurements on He. The authors calcula new constants valid for H and Ne and derive values fo the coefficient l occurring in the differential equatio which determines, for the nearly molecular condition an open gas, the thermomolecular pressure ratio in a tu in which a temp. gradient exists.

533.15.096 25

The temperature variation of the thermal diffusion factor for binary mixtures of hydrogen, deuterium, and heliu MURPHEY, B. F. *Phys. Rev.*, **72,** 834–7 (*Nov.* 1, 1947).— Experimental values of the thermal diffusion factor, have been measured by the twin bulb method for mixtur of H_2 and D_2, H_2 and He, and D_2 and He. Analys were made by means of a mass spectrometer. The valu of α for a mixture of H_2 and D_2 was found to increas slightly with temperature. For a mixture of H_2 and H the value of α was found to decrease slightly as the tem perature is raised. The thermal diffusion factor wa found to be measurable for a mixture of D_2 and He a also appeared to decrease with temperature.

533.21 : 539.893 : 621.51 25

A laboratory compressor for higher pressures. SAG B. H., AND LACEY, W. N. *Rev. Sci. Instrum.*, **18,** 650 (*Sept.*, 1947).—A compressor for the delivery of air pressures up to 12 000 lb/in² is described. It uses a pisto cylinder combination sealed by oil.

533.56 25

Diffusion pumps: a critical discussion of existing theorie AVERY, D. G., AND WITTY, R. *Proc. Phys. Soc., Lond* **59,** 1016–30 (*Nov.*, 1947).—The original work of Gae and others on diffusion pumps is briefly described. critical discussion of this work leads to the formulatio of a more complete theory of the action of the diffusio pump, and this is used to explain the practical chara teristics of a simple form of modern diffusion pump.

533.6.01 : 532.513.032 25

The one-dimensional theory of steady compressible flu flow in ducts with friction and heat addition. HICKS, B. L MONTGOMERY, D. J., AND WASSERMAN, R. H. *J. App Phys.*, **18,** 891–902 (*Oct.*, 1947).—Steady, non-adiabati frictional, variable-area flow of a compressible fluid treated in differential form on the basis of "on dimensional" approximation. The basic equations a first stated in terms of pressure, temperature, densit and velocity of the fluid, considerable simplification the equations being achieved by choosing (Mac number)² as one of the variables. The transforme system of equations is first examined with regard to th existence of a solution. Finally, it is shown that th physical phenomenon of choking is related to restrictio imposed on the variables by the form of the transforme equations. M.-

3.6.011.4 : 534.222.2 : 541.126 259
An investigation, by the method of characteristics, of the eral expansion of the gases behind a detonating slab of plosive. HILL, R., AND PACK, D. C. *Proc. Roy. Soc. A*, 1, 524–41 (*Dec.*, 1947).—The phenomena occurring en an uncased explosive charge is detonated in a fluid dium are examined by hydrodynamical methods. tention is focused chiefly on the pressure and velocity tributions in the gaseous products of the explosion, ich expand laterally behind the detonation wave as it vels down the charge, the results being shown in aphical form. To simplify the problem, the charge, d the gas and fluid fields, were treated as 2-dimensional. e nature of the boundary conditions made it necessary find explicit theoretical formulae for the gas field near charge, and the analysis involved is given at length. r the problem in which the surrounding medium is air, shape and position of the shock waves set up by the losion are calculated. The shock waves are found to straight to the nominal accuracy of the calculations in 5 000) for six charge widths from their intersections th the block of explosive. A.

3.6.011.5 : 531.553 260
The hodograph transformation in trans-sonic flow. '. Tables. FERGUSON, D. F., AND LIGHTHILL, M. J. *oc. Roy. Soc. A*, **192,** 135–42 (*Dec.* 23, 1947).—[See bstr. 3441 (1947)].

3.6.08 261
A hot-wire anemometer for low wind speeds. PARR, G. *J. Sci. Instrum.*, **24,** 317–19 (*Dec.*, 1947).—The paratus measures wind speeds from 0·2 to 2·0 m.p.h. normal temperatures and pressures with an accuracy 2%. The anemometer head is designed to cause min. sturbance to the air flow. Provision is made for rewing into calibrating apparatus which is described. ompensation for variation in ambient temperature is ovided. A.

KINETIC THEORY OF GASES 533.7

VIBRATIONS . ACOUSTICS 534

34.112 : 539.32.096 = 4 *see Abstr.* 427

34.13 262
The vibrations of a pair of truncated cones placed base base. ROLLO, W. T., AND CHAMBERS, L. G. *Phil. Mag.*, **38,** 609–34 (*Sept.*, 1947).

34.22 : 551.596.1 = 5 263
The effect of gravity and of a temperature gradient on ound propagation in the atmosphere. CATTANEO, C. *Nuovo Cim.*, **19,** 230–53 (*Aug.–Oct.*, 1942) *In Italian.*

34.22.096 : 534.321.9 264
Ultrasonic velocity in ethanol-water mixtures. GIA-OMINI, A. *J. Acoust. Soc. Amer.*, **19,** 701–2 (*July*, 1947). —The velocity at 2 Mc/s in mixtures > in either com-onent alone, the composition for max. velocity depending n the temp. A 17% alcohol mixture has temp. coeff. $+4\times10^{-5}$/deg C. [See Abstr. 1761 (1947)].

34.222.2 : 541.126 : 533.6.011.4 *see Abstr.* 259

34.23 : 532.528 *see Abstr.* 249

34.23 : 534.78 *see Abstr.* 274

34.232 265
On the radiation problem at high frequencies. LAX, M., AND FESHBACH, H. *J. Acoust. Soc. Amer.*, **19,** 682–90 *July*, 1947).—The angular distribution of radiation from vibrating cylinder of arbitrary cross-section is considered n the limit of high frequencies. An inhomogeneous integral equation of the first kind is derived for the distribution, and is solved by the method of steepest descents. The first approximation yields the "geometric optics" result in which every element of the radiator radiates normally to itself. Higher order terms are obtained for the case in which the boundary conditions on the radiator surface vary smoothly. The case of an abrupt change in boundary condition is also solved and exhibits typical diffraction effects. The techniques used in this paper have a wide range of applicability to problems of radiation and scattering of waves as they occur in field physics. A.

534.232 266
A simplified method for determining transducer directivity index. KENDIG, P. M., AND MUESER, R. E. *J. Acoust. Soc. Amer.*, **19,** 691–4 (*July*, 1947).—A system is devised whereby the directivity index of an acoustic transducer may be computed by planimeter measurement of the area under a pattern curve. This is made possible by adjusting the co-ordinates of a chart so that total power may be measured as area. A.

534.232 : 534.612.4 267
The practical application of the reciprocity theorem in the calibration of underwater sound transducers. EBAUGH, P., AND MUESER, R. E. *J. Acoust. Soc. Amer.*, **19,** 695–700 (*July*, 1947).—This article contains an integrated discussion of the underlying theory and practical application, including a description of the actual steps involved in performing such a measurement. The practical examples covered are in the field of underwater sound; however, the theory and technique are equally applicable to air acoustics. A.

534.232 : 534.612.4 268
Self-reciprocity calibration of electroacoustic transducers. CARSTENSTEN, E. L. *J. Acoust. Soc. Amer.*, **19,** 702 (*July*, 1947).—Absolute calibration may be obtained on a single transducer without the aid of auxiliary transducers by the use of the reciprocity principle, a transmitted acoustic pulse being reflected at a water/air interface and received by the transducer. [See Abstr. 2023 B (1940)].

534.232 : 534.771 269
Construction and calibration of an improved bone-conduction receiver for audiometry. CARLISLE, R. W., PEARSON, H. A., AND WERNER, P. R. *J. Acoust. Soc. Amer.*, **19,** 632–8 (*July*, 1947).—The construction of an acoustically shielded bone-conduction unit is described. The masses and springs have been proportioned for optimum purity of wave form at low frequency and for extension of the high frequency range to over 12 000 c/s. The precautions taken in preparing an acoustical loudness-balance calibration are described, and the reproducibility of observations is considered. Methods of specifying the response of productions units are shown. A.

534.232 : 621.395.623 = 5 270
Experiments on the artificial ear. BARDUCCI, I. *Alta Frequenza*, **16,** 132–46 (*June–Aug.*, 1947) *In Italian.*—[Abstr. 361 B (1948)].

534.26.082.5 ; 534.321.9 271
Optical study of acoustic fields near diffracting edges. HUBBARD, J. C., ZARTMAN, I. F., AND LARKIN, C. R. *J. Opt. Soc. Amer.*, **37,** 832–6 (*Oct.*, 1947).—Diffraction phenomena in acoustic fields of ultrasonic frequency in air have been photographed by schlieren technique and by shadow methods employing a spark of extremely short duration. Variations of intensity in the field are observed in the immediate vicinity of apertures and obstacles as indicated by theoretical treatment of the problem in a more rigorous manner than that of Kirchhoff. A.

534.321.9 : 534.22.096 *see Abstr.* 264

534.321.9 : 534.26.082.5 *see Abstr.* 271

534.6 = 4 272

C.N.E.T. acoustically lagged room. LEHMANN, R. *Ann. Télécommun.*, **2**, 177–88 (*May*, 1947) *In French.*—The principles of acoustic isolation of a room are discussed and the lagging of the C.N.E.T. room is described in detail. A theoretical and experimental survey is given of the determination of the acoustic field within the room. The use of the room for calibrating microphones and loudspeakers, measuring their directivity patterns, for spectral analysis, measurement of low-intensity sounds and physiological studies, is briefly described. G. F. H.

534.612.4 : 534.232 *see Abstr.* 267–8

534.771 : 534.232 *see Abstr.* 269

534.771 : 612.85 = 3 273

A new audiometer. VON BÉKÉSY, G. *Arch. elekt. Übertragung*, **1**, 13–16 (*July–Aug.*, 1947) *In German.*—An audiometer, designed for automatic registration of threshold sensitivities over 100 to 10 000 c/s, and particularly suitable for deafness diagnosis, is described in detail. The main novel feature is the automatic amplitude control operated by a single button. When pressed, the signal level rises continuously; when released, the level drops at the same rate. The total range covers 140 db. A. L.

534.78 : 534.23 274

Reaction of small enclosures on the human voice. I. Specifications required for satisfactory intelligibility. MORROW, C. T. *J. Acoust. Soc. Amer.*, **19**, 645–52 (*July*, 1947).

534.845 : 539.32 = 3 275

Testing of sound-proofing materials. FURRER, W. *Schweiz. Bauztg*, **65**, 711–14 (*Dec.* 27, 1947) *In German.*—An investigation of the static and dynamic elastic properties of sound-insulating materials (e.g. glass wool fabric, rubber materials, textiles, etc.). The layer of material under test is subjected to controlled static and l.f. dynamic pressures (40–100 c/s), the amplitude of vibration being observed directly by a microscope. Tables and curves are given showing the relation between dynamic and static elasticity-moduli and the variation of interval damping factor with frequency. A. B. W.

534.862.3 : 621.395.625.2 276

Force at the stylus tip while cutting lacquer disk-recording blanks. ROYS, H. E. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **35**, 1360–3 (*Nov.*, 1947).—Lacquer used for disc-recording purposes, being harder than wax, imposes a greater load on the cutting stylus and, consequently, upon the turntable drive system. Equipment was developed to measure the force at the stylus tip while cutting unmodulated grooves. Reducing cutting bounce, a form of instability resulting in a groove of varying width, by using an advance ball or air dashpot was studied. The effect of height of the axis about which the recorder is pivoted above the record surface was also investigated. A.

534.88 277

The German use of sonic listening. HOLT, L. E. *J. Acoust. Soc. Amer.*, **19**, 678–81 (*July*, 1947).

OPTICS . RADIATION . SPECTRA 535

535.14 : 530.145 *see Abstr.* 228

535.14 : 535.338 : 539.15 *see Abstr.* 386

535.14 : 535.43 : 537.531 *see Abstr.* 343

535.214 : 538.56 *see Abstr.* 374

535.23.08 278

The total emissivity of various materials at 100–500°C. BARNES, B. T., FORSYTHE, W. E., AND ADAMS, E. Q. *J. Opt. Soc. Amer.*, **37**, 804–7 (*Oct.*, 1947).—Tot emissivities have been obtained for various metal, carbo paint-coated, and glass samples. The carbon and gla samples were measured at ~500, 320 and 100°C; th others only at 100°C. The equipment consisted of thermopile, three diaphragms and three shutters, all 0°C, and suitable heaters. For calibration, a speci black body at 100°C was used. Its principal feature w a polished conical brass mirror, also at 100°C, fo reflecting black-body radiation to the thermopile. Th resulting emissivity values ranged from 0·82 to 0·91 fo two glass samples and from 0·67 to 0·775 for fuse quartz. For pressed carbon plates, the range was 0·7 to 0·77; for radiator paints, 0·29 to 0·84; for wel polished metals, 0·05 to 0·135.

535.233 + [669.24 + 669.25] : 536.421.4 *see Abstr.* 316

535.241 = 393 27

Photometry. RUTGERS, G. A. W., KERSTEN, J. A. H AND BOERSEMA, J. *Electro-techniek*, **25**, 311–16 (*Oct.* 1947) *In Dutch.*—Sub-standard lamps calibrated at th British National Physical Laboratory in internation lumens have been compared at the Kema laboratori with others calibrated at the Physikalisch-technisch Reichsanstalt in new lumens. The ratio for gas-fille lamps from 60 to 150 watts is found to be (value in in lm)/(value in new lm) = 1·006. A photo-electric com parison between gas-filled and vacuum lamps calibrate at N.P.L. gives a difference of 1·5% between the two sets. J. W. T. W

535.241.431 : 535.317 *see Abstr.* 284

535.243 28

Stable spectrophotometry of small density change CHANCE, B. *Rev. Sci. Instrum.*, **18**, 601–9 (*Sept.*, 1947).—Measurement and control circuits for recording sma density changes by use of several photo-cell circuits ar given. The min. drift rates obtained are 1×10^{-6} part/mi with a differential photo-cell circuit, 3×10^{-5} part/mi with a single photo-cell circuit, and 4×10^{-4} part/min wit a photo-multiplier circuit. The differential and singl photo-cell circuits have been used to measure densit increments of roughly 2×10^{-4} and 1×10^{-3} with a accuracy of ~ 5%. These spectrophotometers are em ployed in studies of the kinetics of unstable intermediate in enzyme action. Although slow drift has been rendere negligible by suitable control circuits and stable amplifier the theoretical limit of performance is not achieved.

535.243 : 535.33.072 *see Abstr.* 286

535.245.22 : 535.361.2 = 3 28

Method of measuring reflection factors by means of th Ulbricht sphere. MÄDER, F. *Bull. Ass. Suisse Élect.*, 3 632–9 (*Oct.* 4, 1947) *In German.*—Describes how, withou elaborate apparatus, the reflection factor of a surface fo perfectly diffused light may be measured by means of th integrating sphere. Measurements are made (*a*) with th sample suspended within the sphere and (*b*) with th sample forming part of the sphere wall; corrections ma be applied if greater accuracy is needed. Without thes the estimated accuracy is 0·005 and with them 0·002. J. W. T. W

535.245.24 : 535.88 : 628.932 28

Determining the light distribution and luminous flux o projectors. BERGMANS, J., AND KEITZ, H. A. E. *Philip Tech. Rev.*, **9** (*No.* 4) 114–22 (1947).—The light distribu tion from apparatus giving a more or less concentrate beam, e.g. a street lighting fitting of the directive type, i usually shown on an iso-candle diagram. The sinu soidal equal-area projection is commonly employed, bu

are advantages in using Lambert's azimuthal ction which is also equal-area. In the case of a t-lighting fitting, the axis of projection is the line gh the fitting parallel to the axis of the street; for an nary type of projector it is the optical axis, and a ription is given of apparatus used to obtain the light ibution in all directions making any given angle with axis. J. W. T. W.

247.4 : 771.534.531.51 : 537.533.73 283

improved microphotometer trace of radially symic patterns. KARLE, I. L., HOOBER, D., AND KARLE, J. hem. Phys., **15**, 765–6 (*Oct.*, 1947).—The plate carryhe pattern (e.g. an electron diffraction pattern) is ed about the centre of the pattern while the photor traverses radially. Fluctuations caused by the sion grains are thus smoothed out. Practical ls are given.

317 : 535.241.431 284

alidity of the cosine-fourth-power law of illumination. DNER, I. C. *J. Res. Nat. Bur. Stand., Wash.*, **39**, 19 (*Sept.*, 1947).—The $\cos^4$ law states that the liance at any point in the image formed by a photohic lens, in the absence of vignetting, $= E_0 \cos^4 \beta$, re E_0 is the irradiance at the centre of the field, and β e angle between the axis of the lens and the conjugate ray in the object space. The law assumes that the is free from distortion, and applies rigorously when diaphragm is between the lens and object and the ct is at ∞. If the diaphragm is between the lens and image plane, there may be cases in which the irance falls off less rapidly from the centre of the field vard than is predicted by the $\cos^4$ law. A type of tive distortion is defined for which the irradiance is orm over the entire image. The departures from tness of the $\cos^4$ law arise partly because the effective of the entrance pupil is a function of the obliquity e incident chief ray. A method is given for measuring variation in effective area. A.

317.25 : 535.822 : 535.421 *see Abstr.* 305

321 : 535.43 *see Abstr.* 307

33 : 537.228.5 : 535.375.5 = 393 285

ptical phenomena associated with atoms in the dised state produced by collision. ZWANIKKEN, G. C. J. *Acad. R. Belge. Cl. Sci.*, **33** (*Sér.* 5) 325–74 (*July*, 1947) *Dutch.*—A mathematical study of the Stark effect ciated with the disturbed state induced in an atom jected to radiation in a variable electric field. A linear k effect is obtained with H atoms, but not with atoms ther elements in a homogeneous field. The treatment xtended to cover resonance and Smekal–Raman iations. Expressions are derived for the calc. of the nsities of the emitted and absorbed radiations. J. G.

33 : 537.531 *see Abstr.* 340

33.072 : 535.243 286

n automatic recording infra-red spectrophotometer. RD, W. S., O'BRYAN, H. M., OGDEN, G., AND LEE, D. *Opt. Soc. Amer.*, **37**, 754–61 (*Oct.*, 1947).—The trophotometer employs a double-beam source, row spectrometer, fast bolometer, and high speed pendrum-recording system. The sample and reference ms are alternately chopped at 10 c/s at the entrance to the spectrometer. The amplified a.c. signal on the ometer is used to drive a variable comb diaphragm he reference beam. The spectra are registered on a rder by a pen mechanically linked to this comb. spectral region covered is between 2 and 16 μ with NaCl prism. The range can be extended to $\sim 26\ \mu$ the use of a KBr prism. Transmission is recorded with an accuracy of $\pm 1\%$, and wavelength with an accuracy of $\pm 0{\cdot}025\ \mu$. Records are reproducible to within $\pm 1\%$ transmission and $\pm 0{\cdot}01\ \mu$. A.

535.33.072 : [537.531 + 539.166] *see Abstr.* 345

535.338 : 535.14 : 539.15 *see Abstr.* 386

535.338.1 : 537.531 = 4 *see Abstr.* 341

535.338.4 287

On continuous emission bands of ICl and IBr. ASUNDI, R. K., AND VENKATESWARLU, P. *Indian J. Phys.*, **21**, 76–82 (*April*, 1947).—A number of new continuous bands has been recorded in the spectra of the mixed halogens ICl and IBr excited by uncondensed discharge from a transformer. These are established by taking juxtaposed spectra of the halogens and the mixed halogens. A tentative explanation of the origin of the bands is given which ascribes them to transitions from stable electronic states to a number of repulsive states that arise from a combination of normal and $^2P_{\frac{1}{2}}$ excited states of the individual halogen atoms. A.

535.338.4 288

Spectra of the halogens, I_2, Br_2 and Cl_2. ASUNDI, R. K., AND VENKATESWARLU, P. *Indian J. Phys.*, **21**, 101–18 (*June*, 1947).—Characteristic continuous or diffuse bands of the fluctuation type previously recorded in the emission spectra have been recently considerably extended and systematized. This proves the existence of the large number of repulsive states theoretically deduced in the excited electronic levels of the molecules. In this paper these data are collected together along with the data on discrete emission bands and on absorption bands (some of which have been recently re-interpreted) and further compared and discussed. A more complete term scheme of the molecules is thus derived and discussed with reference to electronic configurations and dissociation products. A.

535.338.4 289

On the $^2\Pi_u \rightarrow {}^2\Pi_g$ bands of CO_2^+. III–IV. MROZOWSKI, S. *Phys. Rev.*, **72**, 682–98 (*Oct.* 15, 1947).

535.338.4 : 539.132 *see Abstr.* 380

535.338.4–31 290

Ultraviolet band systems of the mercury iodide molecule. III. RAMASASTRY, C., AND RAO, K. R. *Indian J. Phys.*, **21**, 143–52 (*Aug.*, 1947).—[See Abstr. 1476 (1947)]. The band spectrum has been investigated in the region between $\lambda 2400$–$\lambda 2000$, as excited by a specially constructed high frequency oscillator. The *G* and *H* systems are considerably extended; the *G* system is analysed for the first time and a new vibrational scheme is suggested for the *H* system. The two systems have a common final level which is the same as that for the *C* and *D* systems. In the *H* system, the progressions are abruptly cut off after $v' = 2$; this is considered as an instance of predissociation not found in any of the systems of the Hg halides so far analysed. A.

535.343 : 541.57 : 539.132 *see Abstr.* 381

535.343–15 : 535.375.5 291

Infra-red spectrum and depolarization factors of the Raman lines of spiropentane and the Raman and infra-red spectra of 1,1-dimethylcyclopropane, 1-methylcyclobutene, and methylenecyclobutane. CLEVELAND, F. F., MURRAY, M. J., AND GALLAWAY, W. S. *J. Chem. Phys.*, **15**, 742–58 (*Oct.*, 1947).

535.343–15 : 545.82 292

Infra-red spectrometry from 15 to 25μ. PLYLER, E. K. *J. Opt. Soc. Amer.*, **37**, 746–53 (*Oct.*, 1947).—Stray energy of short wavelength from the source is greatly reduced by use of a reflection filter of LiF. The infra-red spectra of cyclopentane, methylcyclopentane, ethyl-

cyclopentane and isopropylcyclopentane have been measured and each has a characteristic spectrum, which can be used in analysis. Also, the spectra of cyclohexane, methylcyclohexane, ethylcyclohexane and secondary butylcyclohexane have been measured and a number of bands which are characteristic of these substances have been observed. A.

535.343.3–31 + 539.133 *see Abstr.* 384

535.343.4 293

Note on the interpretation of the visible absorption spectrum of bromine. REES, A. L. G. *Proc. Phys. Soc., Lond.*, **59**, 1008–10 (*Nov.*, 1947).—The accurate construction [Abstr. 380 (1948)] of the lower parts of the potential-energy curves for the excited states involved in the transitions responsible has enabled a choice to be made between two possible alternative interpretations. A.

535.343.4–14 : 537.228.5 : 539.153 294

The hyperfine structure and the Stark effect of the ammonia inversion spectrum. JAUCH, J. M. *Phys. Rev.*, **72**, 715–23 (*Oct.* 15, 1947).—The expressions for the hyperfine structure separations and the relative intensities are derived with quantum mechanics under the assumption that the splitting is caused by the interaction of an electric quadrupole moment of the N^{14} nucleus with the electric charge distribution in the rest of the molecule. The displacement of the absorption lines in an electric field E of variable strength is considered. General formulae for the positions of energy levels for weak ($E < E_c$) and strong ($E > E_c$) fields ($E_c \simeq 500$ V/cm) are given and the methods outlined for obtaining solutions of the secular equation for intermediate fields ($E \simeq E_c$). The intensities and selection rules for longitudinal and transverse transitions are determined and one particular case ($J = K = 3$) is worked out in detail. A.

535.343.4–14 : 541.57 295

Microwave spectrum and structure of isothiocyanic acid. BEARD, C. I., AND DAILEY, B. P. *J. Chem. Phys.*, **15**, 762 (*Oct.*, 1947).—Stark effect spectra at 19 000–30 000 Mc/s were obtained with HNCS, and with D and C^{13} substituted. The analysis gives reasonable values of angles and bond lengths, but shows that HCNS is not present to >5%.

535.343.4–15 : 545.82 : 545.71 *see Abstr.* 449

535.343.4–32 296

Absorption bands of iodine in quartz ultra-violet. VENKATESWARLU, P. *Indian J. Phys.*, **21**, 43–9 (*April*, 1947).

535.345.1 : 535.41 : 535.543 *see Abstr.* 308

535.345.6 : 535.375.5 297

Raman tube filters. GLOCKLER, G., AND HASKIN, J. F. *J. Chem. Phys.*, **15**, 759 (*Oct.*, 1947).—Cylindrical glass or plastic filters treated with adjusted amounts of dope containing rhodamine or *p*-nitrotoluene are described, for the isolation of the 5 358 Å Hg line from Hg vapour lamps. The dope has also been applied to the lamps themselves.

535.361.2 : 535.245.22 = 3 *see Abstr.* 281

535.361.2–15 298

The diffuse spectral reflectance of paints in the near infra-red. SANDERSON, J. A. *J. Opt. Soc. Amer.*, **37**, 771–7 (*Oct.*, 1947).—A perforated hemispherical reflector made of half of a Pyrex flask has been employed to collect diffusely reflected light from a surface to be measured on a photo-cell or thermopile placed at a focal point of the hemisphere conjugate to the position of the sample. Relative curves extending to 2·5 μ are given for a number of "infra-red reflecting" paints, showing qualitatively the superiority of high index of refraction, large particle size, and low extinction coefficient in producing layers of pigments having high scattering coefficients in the n infra-red. The hemispherical integrator with a W sou and a Wratten 87 filter and with a thermopile more tr indicated the effect of variations in physical characteris of the reflecting material than did photo-cell measu ments embracing wavelengths 0·76 to 1·2 μ.

535.371

Temperature luminescence of ZnO and CaO powd KUDRYAVTZEVA, V. M. *C.R. Acad. Sci. URSS,* (*No.* 7) 581–3 (1946).—The electron vibration band f quencies of the photoluminescence of CaO are compa with the band frequencies of temperature luminescen The emission transfers during the former involve the f two vibration levels of the excited state and a few of first vibration levels of the lower state; during the lat transitions are from the same levels of the excited state high vibration levels of the lower state. Similar resu are found for ZnO. It is concluded that there is a mark resonance level in these lattices and a close connect between the electron transition and the vibration state the lattice. L. S.

535.375.5 : 535.343–15 *see Abstr.* 291

535.375.5 : 535.345.6 *see Abstr.* 297

535.375.5 : 537.228.5 : 535.33 = 393 *see Abstr.* 285

535.375.5.08

Polarization and intensity measurement in Raman spec by the photo-electric method. RANK, D. H. *J. Opt. S Amer.*, **37**, 789–803 (*Oct.*, 1947).—A method is descri for obtaining the true relative intensities of lines ir Raman spectrum excited by natural unpolarized lig Detection and intensity measurement was accomplish by means of a large photo-electric grating spectrogra Correction of intensity measurements for the varia polarization and line breadth of the Raman lines accomplished by methods described in this pa Depolarization factors have been measured for natu unpolarized exciting light (ρ_n), for perpendicula polarized exciting light (ρ_s), and for parallel-polari exciting light (ρ_p). The spectra investigated are those CCl_4, $CHCl_3$, C_6H_6 and CS_2. The values obtained ρ_n agree well with those obtained by numerous vestigators. The values obtained for ρ_s and ρ_p seem be in accord with the predictions of the theory. ρ_p see to be highly sensitive to changes in symmetry of hig symmetrical vibrations, reaching a very large value vibrations where $\rho_n = 0{\cdot}06$ and rapidly approaches 1 for vibrations where $\rho_n = 0{\cdot}30$ as well as for comple depolarized lines. Measurements of ρ_n, ρ_s and ρ_p w made for the Rayleigh scattering of these same molecu using identical apparatus.

535.39

Practical methods of making and using multilayer filt BANNING, M. *J. Opt. Soc. Amer.*, **37**, 792–7 (*O* 1947).—The general method of making an evapora multiple-layer interference filter from two dielectric described for any desired wavelength range. The pro thickness of each layer to give maximum reflection in desired region and at the desired angle of incidenc first computed, and next the visible reflectivity of suc film at normal incidence. This visible reflectivity is u as the gauge to determine the proper thicknesses of films and the point at which the evaporation of each la should be stopped. Practical difficulties encountered making these filters are also discussed. Several exam of special filters for particular purposes are reviewed detail, including infra-red and polarizing filters.

535.39

On the intensity of the light reflected from or transmit through a pile of plates. TUCKERMAN, L. B. *J. Opt. S*

r., 37, 818–25 (*Oct.*, 1947).—A review of the history
ie theory of the reflection of light from a pile of plates
ven. The presence of incorrect formulae in some
ent text and reference books is noted. The formulae
a pile of absorbing plates are derived by a method
rent from that used by Stokes, giving the results in a
rent but equivalent form. An upper bound to the
r caused by assuming an ∞ instead of a finite
ber of multiple reflections is derived. A.

39 : 531.717 : 535.417 *see Abstr.* 304

41 : 535.345.1 : 535.543 *see Abstr.* 308

417 : 532.72.08 303

he theory of an interference method for the study of
sion. KEGELES, G., AND GOSTING, L. J. *J. Amer.*
n. Soc., **69**, 2516–23 (*Oct.*, 1947).—The theory for the
ing and intensity in the interference fringe system
ied by focusing light from a horizontal slit through a
sion boundary has been developed quantitatively by
methods of wave optics. W. R. A.

417 : 535.39 : 531.717 304

oating thickness measurement by interferometry.
HTOLD, M. F. *J. Opt. Soc. Amer.*, **37**, 873–8 (*Oct.*,
7).—Thickness measurements of thin transparent
tings on thick transparent bases by reflection inter-
metry are made possible through use of an immersion
lium of the same refractive index as the base to
nsify interference. A convenient interferometer
prising three essential parts, a "pocket" spectroscope,
ncandescent lamp and a cylindrical immersion tank,
escribed. Its use for rapid, precise measurements of
kness of single and double layer coatings and films in
range of 0·2 to 50 μ is illustrated with spectra. A.

421 : 535.822 : 535.317.25 305

On the influence of the condenser on the resolving power
a microscope. BOLTJES, T. Y. K., AND GORTER, C. J.
c. K. Ned. Akad. Wet., **45** (*No.* 8) 814–19 (1942).—
e transmission of a grating is represented by $T = \sum_n \cos[(2\pi nx/d) - \phi_n]$, and expressions are obtained
the visibility of the "image" of any component in the
e cases when both first-order spectra are admitted by
objective and when only the central and one of the
t-order spectra are present. It is shown that the
bility is less in the latter case. This and the presence
"useless" central spectra is used to explain why the
olving power is not increased by a factor 2 on going
m normal to full-cone illumination. Experimentally
was found that a ruling gave a factor 1·6, and a
tom 1·4. Though < 2, these factors $>$ that of 1·2
gested by van Cittert. H. H. HOP.

5.422 : 535.831 306

Focal plane diffraction anomalies in telescopic systems.
AHAN, A. I. *J. Opt. Soc. Amer.*, **37**, 852–67 (*Oct.*,
47).—A description is given of an anomaly in the form
the Fraunhofer diffraction pattern which is usually
aracteristic of a rectangular aperture. The anomaly is
ated by allowing two plane polarized monochromatic
at waves of different amplitudes and phases, with their
ctric vectors polarized at various azimuth angles with
pect to each other, to be incident on the upper and
ver halves of the diffracting aperture and then com-
ining these two waves in the usual way with a focusing
s. It was found that the forms and spacings of the
fraction bands parallel to the dividing line of the
erture could be changed quite markedly while those
rpendicular to the dividing line were unaffected. The
ms of these bands are calculated theoretically, and are
o observed experimentally by a unique utilization of
e Michelson interferometer. These experiments not
ly make it possible to change the resolving power of a telescope in directions perpendicular to each other, but also suggest the possibility of measuring linear distances in terms of changes in diffraction patterns instead of the usual shift of interference fringes. The forms of the diffraction bands in unpolarized light were also considered both theoretically and experimentally. A.

535.43 : 535.14 : 537.531 *see Abstr.* 343

535.43 : 535.321 307

Optical scattering by dielectric powders of uniform particle size. DEVORE, J. R., AND PFUND, A. H. *J. Opt. Soc. Amer.*, **37**, 826–32 (*Oct.*, 1947).—The spectral-transmission curve of a film of dielectric powder having uniform particle size shows a very pronounced minimum corresponding to the Mie scattering maximum. The wavelength of this "Mie minimum" changes as the refractive index of the medium surrounding the particles is changed. If a film of dielectric powder is prepared and the wavelengths of the Mie minima are determined when liquids of different refractive index are flowed around the particles then, if the wavelength values are plotted against the refractive indices of the surrounding media, the points fall on a straight line that intersects the axis at the refractive index of the powder, thereby providing a method for measuring the refractive index of powders above the range of immersion liquids. A method, using the data for the Mie minima, is described for determining the optimum particle size for white paint pigments. This method is illustrated with data on ZnS and TiO_2. A.

535.43 : 537.531 *see Abstr.* 342

535.434 : 541.182.3.08 *see Abstr.* 446

535.436 : 518.2 : 551.521.3 *see Abstr.* 472

535.515.096 : 538.612.096 = 4 *see Abstr.* 376

535.543 : 535.41 : 535.345.1 308

A tunable narrow-band optical filter. BILLINGS, B. H. *J. Opt. Soc. Amer.*, **37**, 738–46 (*Oct.*, 1947).—Polarization interference filters are described which can have a pass-band ranging from a fraction of an angstrom to several hundred angstroms in width. The pass-band can be shifted to any desired region of the spectrum. The transmission band is formed by the superposition of the polarized channel spectra, produced by x-cut plates of quartz or other birefringent media placed between parallel polarizers. The birefringent plates have thicknesses in the ratio 1 : 2 : 4, etc. The tuning is accomplished by changing the retardation of successive elements so that transmission maxima in the various channel spectra coincide at the desired wavelength. The retardation change can be made mechanically, for example, by stretching supplemental plastic sheets in series with the filter elements, or can be made electrically by using Kerr cells or crystals with high electro-optic coefficients, such as ammonium dihydrogen phosphate. The additional retardation never has to exceed a full wave at the wavelength of peak transmission. The measured transmission of an experimental filter is shown. The electrical tuning method is particularly adapted to cathode-ray oscillograph presentation of spectra. The filter also has possible application in colour reproduction and colorimetry. With a ½ Å pass-band, line-of-sight motion of solar prominences could be determined by the use of the Döppler shift of the prominence radiation. A.

535.551 : 532.517.4 *see Abstr.* 248

535.66 309

The limiting colors due to ideal absorption and transmission bands. GODLOVE, I. H. *J. Opt. Soc. Amer.*, **37**, 778–91 (*Oct.*, 1947).—Various rules are enumerated, to assist in the production of desired colours by chemical manipulation of the spectrum of dyes. A.

535.68 : 548.0 *see Abstr.* 451

535.82 : 537.122 : 537.531 = 4 *see Abstr.* 344

535.822 : 535.317.25 : 535.421 *see Abstr.* 305

535.831 : 535.422 *see Abstr.* 306

535.87 310

Investigation of the figure of small concave metal-replica mirrors. SHIVE, J. N. *J. Opt. Soc. Amer.*, **37**, 849–51 (*Oct.*, 1947).—Optical tests were made on six paraboloidal metal electroplated replica mirrors of 3 in diameter and 2 in focal length, produced from convex glass masters. It was shown that the better replicas reproduced the features of the master surfaces with an average error of 5 or 6 μ/cm along the surface. Three of the replicas gave noticeably distorted images of a point source because of warping, introduced presumably in the process of separating them from the masters after electroplating. A.

535.88 : 628.932 : 535.245.24 *see Abstr.* 282

535.89 : 537.523.4 311

Spark light source of short duration. BEAMS, J. W., KUHLTHAU, A. R., LAPSLEY, A. C., MCQUEEN, J. H., SNODDY, L. B., AND WHITEHEAD, W. D., JR. *J. Opt. Soc. Amer.*, **37**, 868–72 (*Oct.*, 1947).—A simple spark-gap light source together with an associated pulsing circuit has been utilized to produce light flashes of approximately 10^{-7} sec. duration suitable for the study and photography of shock waves and turbulent disturbances in supersonic air streams. A.

HEAT 536

536.2 312

Power losses from heated objects in still air. BARNES, B. T., FORSYTHE, W. E., AND ADAMS, E. Q. *J. Opt. Soc. Amer.*, **37**, 808–9 (*Oct.*, 1947).—The various factors affecting conduction and convection are discussed. Ordinarily, the power carried away from a heated body by these processes cannot be calculated accurately. Two ways of measuring it are described: (1) by boiling water in a container and subtracting from the power input the losses due to evaporation and radiation; and (2) by silvering the bulb of a 500-W tungsten-filament lamp on the outside, and then making the power input such that the average bulb temperature is the same as that of the unsilvered lamp at normal input. A similar test, but with the bulb silvered on the inside, combined with the results of test (2), gave the power radiated by the bulb. 8% of the input to a regular 500-W lamp is carried off by conduction and convection, 11% by bulb radiation, the rest by direct filament radiation. Test (1) showed a conduction and convection loss of $\sim 0{\cdot}05$ W/cm² at 100°C. This exceeded the radiation loss for every surface tested except a radiator enamel (total emissivity 0·77). A.

536.2 : 612.53 *see Abstr.* 480

536.22 : 532.7 : 532.13 *see Abstr.* 246

536.24 313

Temperature distribution in cylinder heated by point source moving along its axis. ROSENTHAL, D., AND CAMERON, R. H. *Trans. Amer. Soc. Mech. Engrs*, **69**, 961–8 (*Nov.*, 1947).—The rise of temperature produced at a given cross-section of the cylinder, as a result of the passage of the heat source at const. speed, tends rapidly to become constant. The factor which governs this trend is a dimensionless product of the following units: (1) The speed of the source; (2) the radius of the cylinder; and (3) the inverse of the heat diffusivity. A.

536.24 : 536.3 314

Some investigations in the field of heat transfer. JAKOB, M. *Proc. Phys. Soc., Lond.*, **59**, 726–55 (*Sept.*, 1947).—Thirtieth Guthrie lecture. Several investigations performed by the author and co-workers are described. heat radiation, a new derivation of the law of emission a gas body of arbitrary shape is given, and the c struction of a small model, consisting of a single-filam galvanometer lamp light-source and a number of pi mounted on a base plate, for the determination of surf and gas radiation is described. In this model, light used instead of the long-wave heat radiation and absorption by photographic films wrapped round pipes is measured by photometric methods. In heat c duction, the problems of temp. distribution in boiler t walls and in electrical coils of simple form due to a lin rise of Joulean heat with temp., and in bodies of sim form developing or absorbing heat at a linear function temp., are discussed. In heat convection, the experimen arrangements and results of studies on free convecti on the heat transfer to a fluid (air, hydrogen and ethyle three gases of very different thermal conductivities, w used) in laminar flow through an annulus, 1 500 mm l formed by two vertical coaxial Ni cylinders of ~ 4 a 8 mm dia. respectively; on forced convection in lami and turbulent flow parallel to a surface, a process practical importance occurring, e.g. on the skin of aeroplane in flight; and on forced convection in turbul flow against a surface, the heat transfer being measu calorimetrically, are described with diagrams and grap The heat transfer in the flow of air perpendicular oblique to a surface is important for the formati melting and sublimation of ice on windshields and ot parts of the outer surface of aeroplanes. The results laboratory tests, converted by means of the theory similarity to actual atmospheric conditions encounte in flight, are used to calculate the amounts of ice t would be formed or sublimed on exposed surfaces un those conditions. S.

536.3 3

Note on the efficiency of radiation shields. LAWS A. W., AND FANO, R. *Rev. Sci. Instrum.*, **18**, 72 (*Oct.*, 1947).—The problem of radiation shields is analy by matrix algebra. A general method is developed for calculation of the efficiency of thick radiation shields infinite thermal conductivity. If the shields are thin, method leads to an explicit, general expression for efficiency of n radiation shields. In this case, the ratio the power required to maintain a radiating surface temp. T with n thin shields to the power required maintain the same temperature without shields is given $\{[\sum_1^n (1/\varepsilon_{mk} + 1/\varepsilon_{ml})] - (n-1)\}^{-1}$, where ε_{mk} and are emissivities of the two sides of the mth shield.

536.3 : 536.24 *see Abstr.* 314

536.413 : 669.215.3 : 548.73 *see Abstr.* 454

536.421.4 : [669.24 + 669.25] + 535.233 3

Freezing points of cobalt and nickel. VANDUSEN, M. AND DAHL, A. I. *J. Res. Nat. Bur. Stand., Wash.*, 291–5 (*Sept.*, 1947). *See also Science*, **106**, 42 (*Oct.* 24, 1947).—The freezing temperatures on International Temperature scale are Ni: 1 455° ± 1 Co: 1 495° ± 1°C. A value of the constant C_2 in Wie (or Planck's) radiation law has been calculated on basis of the observed ratios of brightness of black bo at the freezing points of Ni and Au, Co and Au, and and Au, and the values of the freezing temperatures these metals on the thermodynamic scale as derived fr the work of Day and Sosman. The average value of was 1·438 cm. deg.

536.423 = 4 3

Investigation of the evaporation of distilled water fr a free surface in still air. BLET, D., AND BLET, G. C

. Sci., Paris, 225, 379–81 (Aug. 25, 1947) In French.—
tigation of the influence of size of vessels on the mass
orated and the temp. of the liquid. H. L.

68 : 537.53 = 3 see Abstr. 339

8 : 532.7 see Abstr. 252

8 : 532.7 : 531.19 318

remark on Bose–Einstein degeneracy and the λ-point uid helium. WERGELAND, H. K. Norske Vidensk. . Forh., 19 (No. 22) 80–2 (1946).—It is shown that Bose-Einstein particles are fixed to lattice points hase integral assumes the form valid for Boltzmann tics. Accordingly Bose-Einstein degeneracy can only if the atoms are not localized in a lattice, the potential energy is small compared with the ial energy and the zero-point energy (as is the case liquid He). H. L.

8 : 533.15 see Abstr. 254

8 : 539.155.2 see Abstr. 392

83 : 621.56 319

uantitative study of the Hilsch heat separator. JOHN- A. F. Canad. J. Res. F, 25, 299–302 (July, 1947).— is a simple device for attaining a temperature drop e order of 30 deg. C [Abstr. 1512 (1947)]. An air jet s a long cylindrical chamber near one end and is ted so as to maintain a high velocity vortex. Air n off from the centre of the vortex is cooled, while emainder, flowing down the length of the chamber, rmed. The paper describes results of a quantitative of the performance. Although the maximum ncy is only ~15%, as compared with an ideal atic expansion of the total flow, it provides a prac- means of cooling for many purposes. A.

32 : 578.087.86 see Abstr. 479

THERMODYNAMICS 536.7

: 539.133 see Abstr. 385

: 541.1 320

e foundations of thermodynamics. PARTINGTON, Phil. Mag., 38, 672–7 (Sept., 1947).—Thermo- mics is developed in a form which shows more y than the usual method its applications in physical istry. The introduction of temperature in defining eat unit is unnecessary, and temperature first receives r definition in terms of the second law. Absolute erature is defined in a new way and its identity with rdinary definition is shown. L. S. G.

1 : 541.126 see Abstr. 436

ELECTRICITY 537

81.1 : 621.3.081.1 = 4 321

ionalized units. BUDEANU, C. Bull. Soc. Franç. (Sér. 6) 7, 563–72 (Oct., 1947) In French.—[Abstr. (1948)].

81.1 : 621.3.081.1 = 4 322

rgi system of units in relation to tradition, usage and ng. GRIVET, P. Bull. Soc. Franç. Élect. (Sér. 6) –628 (Nov., 1947) In French.—[Abstr. 221 B (1948)].

22 : 535.82 : 537.531 = 4 see Abstr. 344

22 : 537.564 : 551.510.535 see Abstr. 464

33 : 537.534.74 see Abstr. 353

33 : 539.152.1 : 530.14 see Abstr. 227

33 : 539.172.3 see Abstr. 411

12 : 538.12 : 532.51 323

plications of Kelvin's transformation in electricity, etism and hydrodynamics. WEISS, P. Phil. Mag., 38, 200–14 (March, 1947).—A calculation is made of the effect of placing a magnetic sphere of permeability μ into a magnetic field acting in a medium of permeability $\mu' \neq \mu$. An important new method, involving Kelvin's theorem, is described and this is an improvement on the usual method, yielding series solutions, in that the formulae obtained are neat and lend themselves readily to computation. A hydrodynamical problem, involving a solid sphere placed in a perfect fluid in irrotational motion, is also considered [see Abstr. 1710 (1945)]. L. S. G.

537.226 324

Theory of the ferroelectric effect and clamped dielectric constant of Rochelle salt. MASON, W. P. Phys. Rev., 72, 854–65 (Nov. 1, 1947).—Using the crystal structure determination of Rochelle salt made by Beevers and Hughes [Abstr. 164 (1941)], a theory of the ferroelectric effect and clamped dielectric constant has been worked out using the displacement of the H nucleus in the 1–10 H bond as the ferroelectric dipole. This theory has only one disposable constant, β, the factor of proportionality between the polarization and the Lorentz internal field. Taking the O separation found by X-rays, the dielectric constant for electrons and atoms found by experiment, and the number of molecules/cm^3 found from the X-ray cell determinations, the value of β becomes 4·07, which agrees well with the theoretical value $4\pi/3$ for an isotropic substance. This theory accounts for the clamped dielectric constant at low field strengths, which as shown by measurements presented here has max. values at −18°C and +24°C, the Curie temperatures for the free crystal. This shows that the anomaly must lie in the clamped dielectric constant alone and not in the interaction of the clamped dielectric constant and the piezoelectric effect. This model also accounts for recent measurements which show that the dipole dielectric constant is relaxed at a frequency of about 5×10^9 cycles. A.

537.226 : 621.3.011.5 = 85 325

Remarks on the theory of dielectrics. BRABLC, J. Elektrotech. Obz., 36, 157–65 (May, 1947) In Czech.—The behaviour of permittivity and loss-angle at low frequencies is attributed to the oscillations of heavy particles. On this basis a new theory of dielectric resonance is developed. F. W.

537.226.1 : 621.315.612.4 326

The effective permittivity of two-phase systems. RUSHMAN, D. F., AND STRIVENS, M. A. Proc. Phys. Soc., Lond., 59, 1011–16 (Nov., 1947).—The effective permittivity of samples of Ba titanate with porosities up to 40% v/v has been determined, and an explanation given in terms of Wiener's mixture law. It is shown that the value of the form factor in this law can only be predicted with certainty over the ranges 0–30% and 70–100% porosity, and takes up intermediate values in the 30–70% porosity region. The observed values of ε are in accordance with this hypothesis. A.

537.228.4 327

An apparatus for the observation of the Kerr effect with microsecond electrical pulses. KAYE, W., AND DEVANEY, R. J. Appl. Phys., 18, 912–18 (Oct., 1947).—The apparatus can be used to study the electro-optical effect in liquids and polymers with the minimum of heating. Pulses up to 5 kV of duration 1–1 000 μsec, and repetition rate 60–1 000/sec are used, and the circular polarization induced in plane polarized light passing between the plates is detected photo-electrically and presented on a c.r.o. (Kerr constant)/temp. curves measured down to −80°C are presented for several liquids and polymers. Oscillograms showing differences between orientation and

relaxation time, and both orientation and distortion polarization simultaneously, are published. A.

537.228.5 : 535.375.5 : 535.33 = 393 *see Abstr.* 285

537.228.5 : 539.153 : 535.343.4–14 *see Abstr.* 294

ELECTRIC CURRENTS 537.3

537.311.1 328

On the existence and uniqueness of the solution of the fundamental equation in the theory of metallic conduction. BROER, L. J. F. *Proc. K. Ned. Akad. Wet.*, **50** (*No.* 8) 885–91 (1947).—A general discussion of the equations for weak fields suggests conditions sufficient for a unique solution. A simple proof of the law of detailed balancing in zero field is given. G. J. K.

537.311.31.08 : 621.317.33.029.6 329

Erratum: Conductivity of metallic surfaces at microwave frequencies. MAXWELL, E. *J. Appl. Phys.*, **18**, 928 (*Oct.*, 1947).—[See Abstr. 3534 (1947)].

537.311.33 : 537.312.5 *see Abstr.* 330

537.312.5 : 537.311.33 330

Occurrence of random photo-voltaic barriers in photoconductive layers. SOSNOWSKI, L., SOOLE, B. W., AND STARKIEWICZ, J. *Nature, Lond.*, **160**, 471–2 (*Oct.* 4, 1947).—Photoconductive PbS layers were scanned by a small spot of light; the resulting photo-e.m.f. varied in magnitude and sign from point to point in the layer. This supports the theory previously advanced [Abstr. 2151 (1947)]. Similar effects were observed with Se layers.

537.312.62 : 538.122 = 4 331

Theoretical investigation of some properties of superconductors. PHILBERT, G. *J. Phys. Radium* (*Sér.* 8) **7**, 243–8 (*Aug.*, 1946) *In French.*—The paper deals with some applications of the London equations to superconductors of small dimensions [see Abstr. 5172 (1935)], to the branching of supercurrents in parallel conductors and to the conservation of magnetic flux in rings. H. L.

537.323 332

Thermoelectric power of cadmium oxide. ANDREWS, J. P. *Proc. Phys. Soc., Lond.*, **59**, 990–8 (*Nov.*, 1947).—The thermoelectric e.m.f. (E) against Pt was measured over a temp. range of −110° to 800°C. The results above 100°C are well represented by the formula $E = -aT + b \log_e T - C$, in which the values of the constants a, b, and c vary somewhat according to the previous treatment of the specimen; their values in a number of different experiments are given; their mean values are $a = 0{\cdot}154$, $b = 34{\cdot}3$, and $c = 225$ (E in mV). The results are discussed, and if it is assumed that the number of conduction electrons is given by $n = Be^{-\beta/kT}$, β is found to be 0·034 eV. The sign of the thermoelectric power indicates that CdO is an excess conductor. A.

537.323 333

Thomson coefficients for copper at high temperatures. NYSTRÖM, J. *Ark. Mat. Astr. Fys.*, **34 A** (*Paper* 27) 27 *pp.* (1947).—The Thomson coefficients, σ, for pure Cu (purity checked by measuring the ratio of the electrical resistances at 100 and 0°C, for which the value 1·430 was obtained) between 350 and 750°C, and for an alloy (92% Cu, 8% Pt) between 400 and 900°C, were measured. The results were verified by measuring the thermoelectric force between the Cu and alloy specimens, using Pt and Pt − 10% Rh as intermediate components of the thermocouples. For temperatures > Debye temperature, σ for Cu $\propto$ the absolute temperature, and $\sigma/T = (5{\cdot}4 \pm 0{\cdot}2)10^{-9}$ volt/deg². S. W.

537.361

The passage of liquid conductors through minute orifi in dielectrics. GRIFFITH, M. V., AND THOMAS, A. *Phil. Mag.*, **38**, 81–96 (*Feb.*, 1947).—An investigation v made of the mechanism of the passage of Hg throu cellulose acetate and glass, under the action of elect stress. When the Hg is separated from a semi-conducti liquid by the dielectric, which contains a small hc a p.d. of several kV between the Hg and a metal electrc immersed in the liquid causes the passage of Hg throu the hole in a very finely divided condition, and a colloi suspension of Hg in the liquid is produced. The acti does not occur if the resistivity of the liquid medir $>10^9\ \Omega$ cm, and stable suspensions are not formed the resistivity of the medium $< 10^6\ \Omega$ cm. Tests determining the voltage required to start the action described. It is suggested that the action is due only interfacial surface tension and the mechanical force act on a charged surface. L. S.

537.362

A laboratory investigation of electrosmosis in so MACLEAN, D. J., AND ROLFE, D. W. *Phil. Mag.*, 863–73 (*Dec.*, 1946).—If 2 electrodes are inserted in soil and a direct current is passed between them, wa moves from the positive electrode to the negative. T effect was investigated by passing a small electric curr through a cylindrical specimen of wet soil, the curr density being kept low enough to eliminate much er due to Joule heating. Moisture movements are grea in sandy than in clay soils. For a given soil the amo of water expelled at the cathode varies as the quantity electricity passed through the specimen. L. S.

ELECTRIC DISCHARGES AND RADIATIONS 53

537.521

Dynamic probe characteristics. ANDERSON, T. *Phil. Mag.*, **38**, 179–85 (*March*, 1947).—Experime errors inherent in the usual method for finding characteristic are discussed and a way of avoiding th is described. An alternating voltage of variable freque is applied to the probe, and the voltage/current cha teristic is displayed on the screen of a c.r.o. At a su ciently high frequency, changes in the work function eliminated. These changes were formerly a source error in the determination of the characteristic [Ab 2115 (1938)]. L. S.

537.521

Fluctuations in gas discharges. LOH, H. Y., AND DU G. H. *J. Opt. Soc. Amer.*, **37**, 837–48 (*Oct.*, 1947 Examination of the light output of discharge tubes, u the multiplier-type photo-tube in conjunction wit cathode-ray oscillograph, is suggested as a powerful to the usual electrical measurements in understanding behaviour of electrical discharges in gases. Oscillat appear not only in the voltage and current, but ticularly in the light intensity. These appear to be general, and are not due to the external circuit u They are only of a few per cent magnitude in the cas the voltage and current, but often nearly 100% in the of the light intensity.

537.523.4

On the localized afterglows observed with long spark various gases. CRAGGS, J. D., HOPWOOD, W., MEEK, J. M. *J. Appl. Phys.*, **18**, 919–27 (*Oct.*, 1947 Simultaneous photographs, taken in two perpendic directions, have been obtained of long sparks in var gases at 1 atmos. pressure, in order to decide whethe localized afterglows, noticed as long streaks in rota

or spark photographs, were caused by some discharge ianism or by purely geometrical effects resulting from ortuous nature of the spark channels. The results / that the second explanation is not feasible. Some itative interpretations of the effects are given. A.

523.4 : 535.89 *see Abstr.* 311

53 : 536.468 = 3 339

n increasing ignitibility by electric sparks by local ovement of the gas mixture. MACHE, H. *Öst. Ingen. ., 1* (*Nos* 4–5) 273–7 (1947) *In German.*—Continuing ious experiments on the spark ignition of propane–mixtures, further experiments on improvement of ion are described. The principal factor in observed rovement was found first to be the gas–air proportion next the spark length or temp., while electrode shape onstitution, number of sparks, or gas ionization were nportant. Latest experiments showed that greatest rovement is obtained when (1) optimum mixture urs in the immediate neighbourhood of spark track, (2) gas mixture giving highest flame temp. is em-ed. Greatest improvement was found by heating gas mixtures, and max. effect found when gas in on of spark track was heated. F. LL. J.

.531 : 535.33 340

econd order chlorine *K*-valence band spectra of rides. DAS GUPTA, K. *Indian J. Phys.*, **21**, 129–36 *ne*, 1947).—Chlorine *K*-valence band spectra ($3p \rightarrow 1s$) he second order, i.e. in the region of 9 Å, were studied a concave (gypsum crystal) spectrograph for the li-chlorides, alkaline-earth chlorides, $CdCl_2$, $ZnCl_2$, Cl_2, AgCl, etc. The resolving power is about 2 XU/mm 1·0 eV/mm on the photometer records. The energy erences of "3*p*" emission structures from the chlorine bsorption edge of the corresponding chloride obtained n Stelling's data have been calculated for various rides, and the differences are found to agree well with ultra-violet absorption bands obtained by Pohl and sch for the corresponding chlorides. As to the origin ultra-violet absorption bands in various chlorides, a v explanation has been offered and that put forward by n Hippel has been criticized. The 3*p* bandwidths of ious chlorides have been estimated and are related to ratio of ionic diameters of the constituent elements the chlorides. The experimental results obtained are ter explained by the band-scheme due to Bloch than the atomic model due to Heitler–London. [See Abstr. 70 (1947)]. A.

7.531 : 535.338.1 = 4 341

The *K* emission spectrum of arsenic vapour, As^{33}. ROVEN, L. *C.R. Acad. Sci., Paris*, **225**, 572–4 (*Oct.* 6, 47) *In French.*—The X-rays generated by a high-quency discharge in As vapour at ~0·01 mm Hg were asured with a curved mica crystal spectrometer. The velengths measured are listed and compared with those easured with solid anticathodes.

7.531 : 535.43 342

Correction of measurements of low-angle X-ray scatter-g. GUINIER, A., AND FOURNET, G. *Nature, Lond.*, **160**, 1 (*Oct.* 11, 1947).—The correction to be applied for the lite height of the monochromator beam is worked out r spherical and ellipsoidal particles and shown aphically.

7.531 : 535.43 : 535.14 343

Compton scattering and the emission of low frequency otons. JOST, R. *Phys. Rev.*, **72**, 815–20 (*Nov.* 1, 947).—According to the perturbation theory of the attering of photons, the cross-section for Compton scattering diverges, owing to the multiple scattering effects for low-frequency photons. It is shown that by the application of the method of Bloch and Nordsieck [Abstr. 4026 (1937)] this difficulty can be evaded, and that, to a first approximation, the cross-section for Compton scattering is given by the Klein–Nishina formula. A.

537.531 : 535.82 : 537.122 = 4 344

Microscope images corresponding to an illuminated electron. RISCO, M. *J. Phys. Radium* (*Sér.* 8) **8**, 123–8 (*April*, 1947) *In French.*—The conditions for the formation of a point image in the "X-ray microscope" imagined by Heisenberg are investigated by a relativistic calculation and summed up in the rule: If a stigmatic point *P* is the source of a bundle of rays, characterized by a certain wavelength distribution and passing through an optical system of finite aperture, a moving point-image *A* will be formed if a relativistic observer moving with the image attributes the same wavelength to all rays of the bundle. In addition the point *P* must satisfy the condition of Abbé or Herschel, depending on the direction of the incident beam. The apparent velocity of the point *P* is the Compton "equivalent velocity." A. J. C. W.

[537.531 + 539.166] : 535.33.072 345

A high resolving power, curved-crystal focusing spectrometer for short wavelength X-rays and gamma-rays. DUMOND, J. W. M. *Rev. Sci. Instrum.*, **18**, 626–38 (*Sept.*, 1947).—A transmission-type spectrometer is described having a dispersion of 1·186 XU/mm at short wavelengths. The spectrometer utilizes the (310) planes of quartz in a crystalline plate of dimensions 80 × 70 × 1·0 mm curved cylindrically to a radius of 2 m. High luminosity and resolution are obtained. The geometry of the mechanism permits absolute measurements of sin (Bragg angle) on both sides of the reflecting planes, affording a wavelength range from the *K*-spectrum of Ag to zero. For short γ-rays the source is placed at the focus. A multiple-slit collimator of tapering die-cast lead partitions spaced apart with tapering separators, is used at short wavelengths to transmit the monochromatic diffracted beam and absorb the directly transmitted and scattered heterogeneous beam. The intensity of the diffracted beam is measured with a multi-cellular G.M. tube of high efficiency, provided with a number of thin lead partitions through which the beam passes successively. A.

537.533.7 : 621.397.6 : 621.385.83 346

The motion of electrons subject to forces transverse to a uniform magnetic field. WEIMER, P. K., AND ROSE, A. *Proc. Inst. Radio Engrs, N.Y. Wav. Electrons*, **35**, 1273–9 (*Nov.*, 1947).—[Abstr. 336 B (1948)].

537.533.72 347

The optical properties of axially symmetric magnetic prisms. I. The study of rays in a plane of symmetry, and its application to the design of prism β-spectroscopes. SIDAY, R. E. *Proc. Phys. Soc., Lond.*, **59**, 905–17 (*Nov.*, 1947).—The optical properties of the magnetic field in the neighbourhood of two equal coaxial magnetic poles of opposite polarity used as a magnetic prism are discussed. In this part attention is confined to rays in the plane of symmetry between the poles over which the radial component of the field vanishes everywhere. The focusing properties and aberrations are discussed generally, and detailed calculations are given: (1) by simple analytical methods for the case of zero pole separation (homogeneous field); (2) by numerical computation for the case of a pole separation equal to the radius of either pole. Inferences are drawn concerning the use of such fields in β-spectroscopy, and it is shown that under certain conditions

image formation by the prisms is optically corrected over a very wide aperture, or under other conditions can be corrected in compound instruments consisting of the prism and one or more magnetic lenses. Thus very high resolution is possible in such instruments. The overall optimum design for a β-spectroscope, however, cannot be made without a consideration of the focusing towards the plane of symmetry of rays confined to that plane. A.

537.533.73 348

An objective method for studying electron diffraction by gases. KARLE, J., AND KARLE, I. L. *J. Chem. Phys.*, **15**, 764–5 (*Oct.*, 1947).—The improved trace [see Abstr. 283 (1948)] makes possible mathematical analysis of the weak oscillations superimposed on a steeply falling background.

537.533.73 : 771.534.531.51 : 535.247.4 *see Abstr.* 283

537.533.74 349

Further experiments on the elastic single scattering of electrons by nuclei. BUECHNER, W. W., VAN DE GRAAFF, R. J., SPERDUTO, A., BURRILL, E. A., JR., AND FESHBACH, H. *Phys. Rev.*, **72**, 678–9 (*Oct.* 15, 1947).—Previous measurements [Abstr. 2128 (1946)] have been extended to lower atomic number by using Be as a scattering material. These show that, for angles up to 60° and for electron energies of 2·1, 2·2 and 2·3 MeV, the ratio of observed scattering to that predicted by the Mott formula is 0·99, with a standard deviation of 0·04. Measurements have also been made on Al in this angular and energy range, and the ratio of observed scattering to that predicted is found to be 0·99 with a standard deviation of 0·05. The earlier results for Al at 2·27 MeV, which were reported as anomalous, were presumably due to experimental errors of undetermined origin. The present results, together with those reported earlier, show that, in this angular and energy range, the elastic single scattering of electrons is in good agreement with theory for nuclei ranging in atomic number from 4 to 79 (Be to Au). A.

537.533.74 : 530.145.6 350

The effect of spin-spin interaction on high velocity scattering. KAR, K. C. *Indian J. Phys.*, **21**, 69–75 (*April*, 1947).—The complete Mott formula of high speed electron scattering by atoms has been derived wave-statistically by assuming a spin-spin interaction potential somewhat similar to that taken by Dirac and Van Vleck in magnetism. The spin-orbit interaction is taken as in the Thomas effect. The theory has been applied to electron-electron scattering. The formula thus derived agrees with Möller's formula only at the important limiting cases where the velocity in the relativistic region is (*a*) small and (*b*) large. The case of electron-positron scattering has also been considered. A.

537.533.8 = 4 351

The true secondary emission coefficient in metals. PALLUEL, P. *C.R. Acad. Sci., Paris*, **225**, 383–5 (*Aug.* 25, 1947) *In French.*—The true secondary emission is defined as the secondary emission minus back scattered electrons and minus secondary electrons resulting from impacts between atoms and back scattered electrons. At high energies the true secondary emission coefficient is given by a convergent series, convergence being slow for heavy elements and rapid for light. Measurements on light elements give $\sigma = \text{const.}/E_p$ (E_p = energy of primary electrons) which is in agreement with theory. A. H. W. B.

537.533.8 : 537.561 *see Abstr.* 360

537.534 : 537.541 *see Abstr.* 354

537.534.72 : 538.691 352

Fringing flux corrections for magnetic focusing devices. COGGESHALL, N. D. *J. Appl. Phys.*, **18**, 855–61 (*Oc* 1947).—When a charged particle approaches a region uniform magnetic field its trajectory is affected by th fringing field. Compensation for the effect of th fringing field may in some cases be achieved by the u of virtual field boundaries which are outwardly displace from the actual boundaries. A definition of the virtu boundary in terms of the effect of the fringing field upc the trajectories is formulated. A procedure for calcula ing the displacement d of the virtual from the actual fiel boundary is given using the methods previously develope for calculating ion trajectories in non-uniform magnet fields. Using this procedure, several values of the di placement for various magnet dimensions and conditior have been calculated. A method of altering the geomet of sector-type mass spectrometers to correct for the effec of the fringing fields is proposed. It is shown that th angular and spatial separations of the individual io trajectories in an ion beam of small angular spread as approaches a uniform field region through a fringin field are approximately the same as for the ideal cas wherein the magnet field changes discontinuously at th boundary.

537.534.74 : 537.133 35

Scattering of protons by deuterons. SHERR, R., BLAIR J. M., KRATZ, H. R., BAILEY, C. L., AND TASCHEK, R. F *Phys. Rev.*, **72**, 662–72 (*Oct.* 15, 1947).—A scatterin chamber based on the design used by Herb *et al* [Abstr 3011 (1939)] in the measurement of proton-proto scattering was used. The incident protons were ac celerated by a 3·5-MeV "long tank" generator. Th geometry and the current and pressure measurement were checked by comparing the measurements of proton proton scattering at 2·1 MeV with the earlier work Results on proton-deuteron scattering at 0·825, 1·51 2·08, 2·53, 3·00 and 3·49 MeV were obtained. Th absolute cross-sections per unit solid angle show th presence at all energies studied of higher order wave A minimum in the scattering is observed near 90° at th low energies; the minimum shifts to large angles wit increasing energy. The cross-sections at all angle decrease with increasing energy but the ratio of the cross section at 150° to the minimum increases gradually fron 2·3 at 1·51 MeV to 3·0 at 3·49 MeV. The presen results at 825 keV do not show the large anomaly foun by Tuve, Heydenburg and Hafstad at 830 keV [Abstr 5328 (1936)]. A

537.541 : 537.534 35

A radio-frequency ion source with high percentage yiel of protons. RUTHERGLEN, J. G., AND COLE, J. F. *Nature, Lond.*, **160**, 545–6 (*Oct.* 18, 1947).—See Abstr 2344 (1946). The proton yield, compared to H_2^+ an H_3^+, is improved by maintaining a high ionization den sity, and making the discharge vessel walls of clean glass with a minimum of metal. A 240 μA beam of 60% protons could be obtained by critical adjustment of steady axial magnetic field.

537.542 35

Discharge spread in Geiger counters. I. With self-quenching gases. CRAGGS, J. D., AND JAFFE, A. A *Phys. Rev.*, **72**, 784–93 (*Nov.* 1, 1947).—Many aspects o counter behaviour are as yet unexplained. In particular the extent to which the photons produced in the counte discharge are of importance, and the manner in which they are absorbed in the counter gas, seem to have been insufficiently studied. The experiments described here were made with single wire, divided cathode, counters of various types. The results show that photon absorption seems to be less complete than is often thought, but that

n such absorption is fairly small, it may be almost ely manifest as a cathode, not a gas, effect, as shown xperiments with a new type of divided cathode counter hich the cathode effect is virtually eliminated. A.

542 356

me photo-electric thresholds for Geiger–Müller counters evaporated cathodes. RAMM, C. A. *J. Sci. Instrum.*, 320–1 (*Dec.*, 1947).—To determine the influence on photoelectric thresholds of G.M. counters prepared manner similar to that described by De Vos and Du [Abstr. 514 (1946)], measurements with several ode metals have been made. It was found that ad desirable properties for counters with evaporated odes. A.

542 : 539.16.08 357

in window counter with special mica-to-glass seal. C. S., MEAKER, C. L., AND GLASSFORD, H. A. *Rev. Instrum.*, **18**, 693–5 (*Oct.*, 1947).—The counter has developed for the detection of low energy electrons radioactive isotopes such as C^{14}. It is simple to truct and vacuum tight. It can be operated without nal quenching and exhibits flat plateaus of 100–V. The average useful life is ~1 yr. A.

542 : 539.185 *see Abstr.* 423

542 : 539.185.08 358

ounter for use in scattering and disintegration experi-s. KOONTZ, P. G., AND HALL, T. A. *Rev. Sci. um.*, **18**, 643–6 (*Sept.*, 1947).—A chamber is described for studying the angular distribution of scattering of ons by He. The counter can be used either as an ation chamber or as a proportional counter. Results sts made with the N (n, p) reaction for slow neutrons ncluded. These tests show a width of the 0·6-MeV at ½-height to be ~35 keV, indicating that it should ossible to separate low energy neutron groups which in energy by ~50 keV. A.

542.2 : 539.16.08 *see Abstr.* 394

6 : 539.13 : 551.510.4 *see Abstr.* 463

6 : 539.185.9 *see Abstr.* 426

61 359

note on the significance of appearance potentials of in a mass spectrometer. MARINER, T., AND BLEAK-W. *Phys. Rev.*, **72**, 807–14 (*Nov.* 1, 1947).—The icance of appearance potentials determined by the ommon methods is treated with the aid of some ifying assumptions. Arguments favouring the al use of the more commonly used method are given, t is pointed out that the initial part of the appearance tial curve of an ion cannot generally lead to un-guous conclusions concerning the nature of the ionic involved in the production of the ion. A.

61 : 537.533.8 360

e ionization and dissociation of formic acid monomer ectron impact. MARINER, T., AND BLEAKNEY, W. *Rev.*, **72**, 792–806 (*Nov.* 1, 1947).—The appearance tials of various fragment ions have been measured, low velocity electrons and a mass spectrometer. reactions producing the fragments are discussed. e is evidence of a *trans*-form of HCOOH, of energy 2–3·0 k cal/mole different from the *cis*-form. A.

61 : 539.154 : 539.153 = 3 *see Abstr.* 389

64 : 537.122 : 551.510.535 *see Abstr.* 464

68 : 551.510.535 361

e basic reactions in the upper atmosphere. II. The y of recombination in the ionized layers. BATES, ., AND MASSEY, H. S. W. *Proc. Roy. Soc. A*, **192**, (*Dec.* 23, 1947).—See Abstr. 899 (1947). Results of recent work make the ionic recombination theory very difficult to maintain. Two alternative theories, dust recombination and molecular recombination, are considered. Only the latter is at all promising. In the E layer the recombination process would be $O_2^+ + e \rightarrow O' + O''$, while in F_1 the effective reactions would be

$$\left.\begin{matrix} O^+ + XY \rightarrow XY^+ + O \\ XY^+ + e \rightarrow X' + Y' \end{matrix}\right\}, \quad \left.\begin{matrix} N_2^+ + XY \rightarrow XY^+ + N_2 \\ XY^+ + e \rightarrow X' + Y' \end{matrix}\right\}$$

and $N_2^+ + e \rightarrow N' + N''$. The molecule XY possesses a lower ionization potential than O and need form only a very small fraction of the upper atmospheric content at the altitudes concerned. It is not identified but may be O_2 or NO. The reaction involving O^+ must be introduced, as otherwise the concentration of this ion would build up to impossibly large values. In F_2 the same reactions would be supposed to occur as in F_1, but the reduced amount of XY would lead to a lower and pressure-dependent recombination coefficient. A.

COSMIC RAYS 537.591

537.591 : 539.172 *see Abstr.* 407

537.591 : 539.18 *see Abstr.* 417

537.591.1 362

Cosmic radiation variations and meson disintegration. HOGG, A. R. *Proc. Roy. Soc. A*, **192**, 128–34 (*Dec.* 23, 1947).—Measurements of cosmic radiation were made during 5 yr at the Commonwealth Observatory, Canberra, using an ionization chamber screened by 10 cm of Pb. The results are examined to determine whether the observed magnitudes and variations of the temp. effect, and the barometer effect, may be accounted for by the theory of meson decay in the atmosphere. Satisfactory agreement is found between the value of the rest life of the meson τ_0, as obtained by 5 different methods of examining the meteorological variations of cosmic rays. The absorption coeff. of mesons in dense matter, μ, may also be obtained from the meteorological variations and agrees with a more directly determined value. Values of τ_0 are in the range 2–4 μsec and μ in the range 0·0014 and 0·0021 $cm^{-2}\,g^{-1}$. A.

537.591.1 : 539.18 363

Meson formation and the geomagnetic effects. JÁNOSSY, L., AND NICOLSON, P. *Proc. Roy. Soc. A*, **192**, 99–114 (*Dec.* 23, 1947).—The experimental data on the cosmic-ray geomagnetic effects are used to provide information on the nature of the primary cosmic rays and on the mode of production of the meson component. The relevant arguments are first reviewed qualitatively and then elaborated by a quantitative analysis, which is not dependent upon any specific theory of meson production. Three main possibilities are discussed, the so-called proton, "mixed" and soft component hypotheses. It is concluded that the bulk of the mesons must arise from protons (or possibly other heavier positively charged particles). The analysis suggests that the average multiplicity of the process of meson production $\simeq 9$. The asymmetry at high altitudes suggests that the primary radiation consists of protons and electrons (equally positive and negative) in the ratio of about one proton to 4 electrons. A.

537.591.1 : 539.18 *see Abstr.* 418

537.591.15 364

Extensive penetrating cosmic ray showers. BROADBENT, D., AND JÁNOSSY, L. *Proc. Roy. Soc. A*, **191**, 519–23 (*Dec.*, 1947).—Showers were recorded with an arrangement consisting of a penetrating shower set P and an extension E containing shielded and unshielded counters.

The effective density integral spectrum of the showers observed is given by $D(x) = Ax^{-0\cdot5}$ (x = number of particles/m²). The rate of shower coincidences decreases only slightly when E is moved from a distance of 0·5 m to a distance of 9 m from P. The ratio of the coincidences obtained with shielded and unshielded extension counters does not change noticeably with increasing separation between E and P. The results are based on approximately 10 000 hr of recording. A.

537.591.15 = 5 365

On the composition of the extensive air showers. COCCONI, G., LOVERDO, A., AND TONGIORGI, V. *Nuovo Cim.*, **2**, 28–34 (*April*, 1944) *In Italian.*—Measurements were made at 2 200 m above sea-level on the frequency of air showers composed partly of penetrating particles. These showed that almost all electron showers are accompanied by meson showers, and the authors conclude that the same process is responsible for the production of both. G. P. S. O.

537.591.15 = 5 366

On the extensive air showers. COCCONI, G., LOVERDO, A., AND TONGIORGI, V. *Nuovo Cim.*, **1**, 314–24 (*June*, 1943) *In Italian.*—The dependence of the measurement of the density of the showers on the effective area of the counters used is discussed. From their interpretation of their experimental results, the authors deduce the law $\nu(\Delta) \propto \Delta^{-\gamma}$, where ν is the frequency of showers of density Δ. The number of ionizing particles in the showers observed at 2 200 m above sea-level is found to be 5×10^{-3}/min cm². G. P. S. O.

537.591.3 : 539.18 *see Abstr.* 419

537.591.3 : 539.18 = 5 367

On the diffusion of mesons through lead. FESTA, C. *Nuovo Cim.*, **1**, 445–53 (*Dec.*, 1943) *In Italian.*—By the displacement of a Pb block between the counters of a cosmic-ray telescope, the diffusion of mesons through Pb has been measured. The results are in agreement with the theory of E. J. Williams. G. P. S. O.

537.591.3 : 539.18 = 5 *see Abstr.* 420

MAGNETISM 538

538.114 368

Mechanism of ferromagnetic dispersion. BIRKS, J. B. *Nature, Lond.*, **160**, 535 (*Oct.* 18, 1947).—Further measurements [Abstr. 2181 (1947)] of high-frequency permeability of γ-Fe_2O_3/wax mixtures in a static magnetic field have been made. It appears that the primary mechanism is domain-spin rotation, and is a strong- rather than a weak-field phenomenon, lagging behind the field at high frequencies. The results are in good agreement with the theory of Landau and Lifshitz [Abstr. 5226 (1935)].

538.12 : 532.51 : 537.212 *see Abstr.* 323

538.122 : 537.312.62 = 4 *see Abstr.* 331

538.221 = 4 369

Paramagnetism of certain manganese compounds. SERRES, A. *J. Phys. Radium* (*Sér.* 8) **8**, 146–51 (*May*, 1947) *In French.*—MnAs, MnSb, Mn_2Sb and MnSn are ferromagnetic. MnAs follows the Weiss law at >126°C, MnSb at > 445°C, but Mn_2Sb and MnSn do not obey the law. MnS, MnSe and MnTe display transition points. MnS and MnSe obey the Weiss law at > ordinary temp. The transition point of MnTe is 307°K. The variation of magnetization (χ) with temperature (θ) in the range liquid-air temperature to 772·5°K shows that χ increases with θ from 91°K to 307°K, then decreases at a rate which initially exceeds that anticipated from Weiss's law but at >700° appears to follow this law. W. R. A.

538.221 : 539.215 3

Ferromagnetic parameters and grain size. KOENIG BERGER, J. G. *Phil. Mag.*, **38**, 640–57 (*Sept.*, 1947).- Variation of the parameters with grain size is studie The coercive force and the magnetic field correspondi to max. volume susceptibility k_m increases with gra size; and k_m decreases as the first power of the diamet (d) of the cross-section perpendicular to the field f bodies like cylinders or grains which change size in 2 3 dimensions. For films the change varies as $\sqrt$ Remanence is unaltered, so that the hysteresis loop flattened and the hysteresis loss increases with i creasing d. A theory of the influence of size is given. L. S.

538.222 : 539.153 : 538.569.3 3

Paramagnetic resonance and magnetic energy levels chrome alum. BAGGULEY, D. M. S., AND GRIFFITH J. H. E. *Nature, Lond.*, **160**, 532–3 (*Oct.* 18, 1947). High-frequency (3–10 cm wavelength) absorption pea of a single crystal of Cr alum in a steady magnetic fie at right angles to the h.f. magnetic field have be observed. Their variations with magnetic field are co pared with those based on Broer's calculations of t lowest energy levels of the Cr^{3+} ion [Abstr. 2632 (194 and substantial agreement found. The best value for t "splitting" of the energy levels at zero magnetic fie appears to be 0·12 cm^{-1}.

538.224 : 541.67 *see Abstr.* 448

ELECTROMAGNETISM ELECTRODYNAMICS 538.3/.5

538.3 : 539.15 : 530.145 *see Abstr.* 229

538.3.081 : 621.3.081.5 3

Dimensional analysis of electromagnetic equatio WINZEMER, A. M. *Proc. Inst. Radio Engrs, N.Y. W Electrons*, **35**, 1383–4 (*Nov.*, 1947).—[Abstr. 222 B (1948

538.311 3

Magnetic conductibility of frame coils. ŘEZNÍČEK, AND MALÝ, K. *Bull. Int. Acad. Tchèque Sci.*, **45**, 233– (1944).—A shortened version in English of a pa originally published in Czech on a new method calculating the magnetic conductibility due to elect current systems. This is effectively defined thus: if denotes the flux of the magnetic induction vector through a surface element perpendicular to the magne lines of force, H the magnetic field strength at the e ment, y the magnetic conductibility, then $d\Phi = Hds$ where ds denotes an element of arc along a magnetic li of force. Formulae giving y for various current syste are developed using an intrinsic system of orthogo curvilinear co-ordinates formed by the magnetic lines force, the current-lines, and a system of curves mutua orthogonal to these. The magnetic conductibility o rectangular frame-coil of rectangular cross-section worked out in detail. V. C. A

538.56 : 535.214

Radiation pressure. STOKES, A. R. *Nature, Lo* **160**, 532 (*Oct.* 18, 1947).—A physical description is gi of the force exerted by a progressive electromagn wave on a bound electron, i.e. one which draws ene from the field.

538.566.3 : 621.396.11

On the propagation of e.m. waves through the up atmosphere. SAHA, M. N., BANERJEA, B. K., AND GU U. C. *Indian J. Phys.*, **21**, 181–98 (*Aug.*, 1947).—T paper reports a comprehensive working out of the probl of an ionized atmosphere traversed by a magnetic fi

the case of the earth's atmosphere. Expressions are ced for electrical polarization and complex con- ivity for such an atmosphere when traversed by radio s, in a teasor-form, as first suggested by Darwin. equations of propagation of r.f. waves through such dium are obtained by the use of cardinal axes, and quations of vertical propagation are then deduced. essions are obtained for refractive indices of ordinary extraordinary waves, which agree with the expressions by Appleton. Expressions are obtained for rization, absorption, etc., of the radio waves travelling ne ionosphere. Curves are given for the polarization and refractive indices of the two waves as functions ne magnetic latitude of the place of observation. A.

569.3 : 539.153 : 538.222 *see Abstr.* 371

MAGNETIC EFFECTS 538.6

612.096 : 535.515.096 = 4 376

hermal variation of the magnetic birefringence of ain organic liquids. RABINOVITCH, J., AND KUNZL, V. *Phys. Radium* (*Sér.* 8) **8**, 111–15 (*April*, 1947) *In ich.*—Measurements of the thermal variation of the gnetic birefringence of $PhNO_2$, PhCl, *o*-dichloro- zene, and mesitylene have been made and are com- ed with those of Goldet [Abstr. 4468 (1938)] and of dde [Abstr. 225 (1939)]; they agree with the former. a for β-ethyl- and α-bromo-naphthalene are also given discussed. W. R. A.

691 : 537.534.72 *see Abstr.* 352

OMIC AND MOLECULAR STRUCTURE 539

.13 : 532.7 377

orces between tetrahalide molecules. HILDEBRAND, H. *J. Chem. Phys.*, **15**, 727–36 (*Oct.*, 1947).—A review the evidence furnished by melting and boiling points, ropy of fusion and evaporation, crystal structure, ic-bond character, radii, Raman frequencies, energy evaporation and differential energy of expansion, arizability, and solubility relations has led to the lowing conclusions: (1) Hindrance to rotation is small liquid CCl_4 and CBr_4 but increases with increasing tius ratio of central atom to halide atom. This indi- es that the van der Waals radii of the halide atoms in se liquids are considerably smaller than those assigned Pauling. (2) In spite of the hindrance to rotation, the ubility relations can be calculated with considerable curacy by means of equations derived for spherical olecules with radial force fields. (3) Attraction between olecules of different species is not appreciably influenced the kind of bonding orbitals of the central atom, but strongly influenced by the ionic character of the bond. The apparent anomaly of the low boiling point and ernal pressure of $SiCl_4$ is due to the large increase in olal volume between CCl_4 and $SiCl_4$; the attraction nstant increases uniformly with *M-X* distance in the ies of chlorides of C, Si, Ge, Ti, Sn. (5) The attraction nstant is closely related to the square of the polariz- ility, in accordance with the London theory. (6) The o isotropic Raman frequencies for the chlorides of C, , Ge, Ti, Sn, Pb decrease uniformly with increasing -*X* distance. (7) None of the properties of $SiCl_4$ quires for its explanation the assumption of "double nd resonance." A.

9.13 : 537.56 : 551.510.4 *see Abstr.* 463

9.132 378

Note on a form of the secular equation for molecular brations. WILSON, E. B., JR. *J. Chem. Phys.*, **15**, 736–8 (*Oct.*, 1947).—By starting with the Hamiltonian form of the equations of motion, the problem of the small vibrations of a polyatomic molecule can be solved with the aid of a secular equation twice the usual size. This equation, however, is readily adapted to solution by electrical circuits and has the important advantage of having as elements the force constants and inverse kinetic energy coefficients ("*G*" matrix elements) directly. The force constant matrix elements occupy one off-diagonal corner of the secular equation, the *G* matrix elements are in the other off-diagonal corner, the circular frequencies ($2\pi\nu$) appear on the principal diagonal, and all other elements are zero. A.

539.132 379

Simple potential functions for HF and $[F - H \,.\, F]^-$. DAVIES, M. *J. Chem. Phys.*, **15**, 739–41 (*Oct.*, 1947).—Calculations based on an electrostatic model have been made of the stabilizing energy in $[F - H \,.\, F]^-$. The terms used have first been tested on the HF molecule and the distortion of the latter in the bifluoride ion is estimated. The calculated value of $-\Delta U$ for $[F-H \,.\, F]^-$ is 47·3 kcal/g ion, in satisfactory accord with thermochemical estimates. A.

539.132 : 535.338.4 380

The calculation of potential-energy curves from band-spectroscopic data. REES, A. L. G. *Proc. Phys. Soc., Lond.*, **59**, 998–1008 (*Nov.*, 1947).—Analytical expressions equivalent to the Rydberg–Klein graphical construction have been derived for the calculation of potential-energy curves of diatomic molecules from band-spectroscopic data. These expressions have been shown to lead to satisfactory values for D_e and r_e and, in contrast to the Rydberg method, enables the potential-energy (p.e.) curve to be evaluated with accuracy in the region of the minimum. The Morse function has been shown to satisfy the analytic expressions where a quadratic in $(v + \frac{1}{2})$ has been used to express the band data. A method for dealing with electronic states in which a discontinuity in the law of force occurs has been outlined. By using a series of quadratics to satisfy the band data, the calculation of p.e. curves is reduced to a rapid and accurate procedure. The methods outlined have been illustrated by the computation by several procedures of the p.e. curve for the $^3\Pi_{0^+_u}$ state of Br_2. A.

539.132 : 535.343 : 541.57 381

Ionic character of bonds and spectra of absorption. BLUMENFELD, L. A. *C.R. Acad. Sci. URSS*, **52** (*No.* 7) 597–9 (1946).—A quantitative relation is obtained between the ionic character of the bonds and the energy difference between the ground and excited level in the case of resonance of the homopolar and excited states. With an increase of resonance between ionic and homopolar structures the absorption spectrum shifts to shorter wavelengths. L. S. G.

539.132 : 541.57 382

The electronic structure of conjugated systems. II. Unsaturated hydrocarbons and their hetero-derivatives. COULSON, C. A., AND LONGUET-HIGGINS, H. C. *Proc. Roy. Soc. A*, **192**, 16–32 (*Dec.* 23, 1947).—The theory of I [Abstr. 3274 (1947)] is applied to hydrocarbons and their hetero-derivatives. An equation relates differences in activation energy to electron densities and atom polarizabilities for a heterolytic reaction at different positions in a conjugated system. The equations of I are then applied to hydrocarbons containing no odd-membered unsaturated rings. In such hydrocarbons all the electron densities are unity, and it is proved that when one coulomb integral is altered slightly, the electron densities are alternately increased and decreased through-

out the molecule. This fact provides a theoretical basis for the experimental law of alternating polarity in conjugated systems containing a hetero-atom. A.

539.133 383

The dependence on state of the apparent dipole moments of ammonia, methylamine, dimethylamine, and trimethylamine. Le Fèvre, R. J. W., and Russell, P. *Trans. Faraday Soc.*, **43**, 374–93 (*June*, 1947).—Suitable apparatus is described. The apparent moments found, in D. units, for the liquid, dissolved (C_6H_6), and gaseous states, are respectively: NH_3, 0·93, 1·40, 1·45; $MeNH_2$, 1·08, 1·46, 1·28; Me_2NH, 1·13, 1·17, 1·02; Me_3N, 0·72, 0·86, 0·64. These results illustrate behaviour forecast by a number of theories for molecules specifiable by elongation or extension, in some cases along, and in others across, their dipole axes. A.

539.133 + 535.343.3–31 384

The electric moments and ultra-violet absorption spectra of some derivatives of cyclopropane and ethylene oxide. Rogers, M. T. *J. Amer. Chem. Soc.*, **69**, 2544–8 (*Oct.*, 1947).

539.133 : 536.7 385

The thermodynamics and molecular structure of *cyclo*-pentane. Kilpatrick, J. E., Pitzer, K. S., and Spitzer, R. *J. Amer. Chem. Soc.*, **69**, 2483–8 (*Oct.*, 1947).—The structure has been deduced from consideration of published data on its electron diffraction, infra-red and Raman spectra, entropy, and specific heat. The ring is puckered, but the puckering is not of a definite type since the angle of max. puckering rotates around the ring. This conclusion is not in conflict with other properties of the molecule. Vibration frequencies have been assigned and values of $-(G - H_0)/T$, S, $(H - H_0)/T$, and C_p from 298·16° to 1 500°K are tabulated. W. R. A.

539.15 : 530.162 = 4 *see Abstr.* 231

539.15 : 535.338 : 535.14 386

Correspondence principle analysis of double-photon emission. Wheeler, J. A. *J. Opt. Soc. Amer.*, **37**, 813–17 (*Oct.*, 1947).—The process of simultaneous emission of two photons (of continuous probability distribution in energy) in the transition from one discrete quantum level to another is here analysed in the correspondence principle limit in which the quantum numbers of the two states are large and the change in quantum number is small by comparison. In this limit, it proves possible to define a classical dynamical quantity, the frequency analysis of whose classical variation with time in a definite orbit determines in the given approximation the absolute transition probability and intensity distribution in the continuous spectrum in question. A.

539.15 : 538.3 : 530.145 *see Abstr.* 229

539.152.1 : 537.133 : 530.14 *see Abstr.* 227

539.152.1 : 539.172 *see Abstr.* 408

539.152.2 387

Nuclear magnetic relaxation. Bloembergen, N., Purcell, E. M., and Pound, R. V. *Nature, Lond.*, **160**, 475–6 (*Oct.* 4, 1947).—The experimental values obtained for "spin-lattice" relaxation times are very much smaller than theoretical. In liquids and gases, local fields, varying under Brownian motion, provide another mechanism of interaction strong enough to account for the discrepancy. This depends on the viscosity, and the relaxation time will be a minimum at a temp. where the Brownian motion correlation time = 1/(Larmor frequency of the nucleus). Results are given for glycerin showing this minimum. The effect is also present to a certain extent in solids. The spin-spin interaction is reduced by Brownian motion, so that relaxation time is least, and line breadth greatest, at low temps.

539.152.2 38

Nuclear magnetic moments. Latham, R. *Proc. Phy. Soc., Lond.*, **59**, 979–81 (*Nov.*, 1947).—A regular chang in the nuclear magnetic moments of the elements as function of their charge and spin is described, and connection is suggested between this and the excess of th number of neutrons over the number of protons in th nucleus.

539.153 : 537.228.5 : 535.343.4–14 *see Abstr.* 294

539.153 : 537.561 : 539.154 = 3 38

Ionization potential and electron screening in the periodi system. Finkelnburg, W. *Z. Naturforsch.*, **2a**, 16–2 (*Jan.*, 1947) *In German.*—Regularities in the increase o the screening number on passing from element Z t element $Z + 1$ are pointed out. L. F

539.153 : 538.569.3 : 538.222 *see Abstr.* 371

539.153 : 541.57 39

Position of nodes in atomic wave functions. Moffitt W. E., and Coulson, C. A. *Phil. Mag.*, **38**, 634–4 (*Sept.*, 1947).—The radial nodes in atomic 2*s* wave func tions are discussed, and it is shown that they occur a distances comparable with those to be expected from suitable hydrogenic 2*s* orbital. Graphs show the densit and charge distribution in Pauling's hybridized *s–p* orbit for a C atom, and some results on bond length an reactivity are deduced. L. S. G

539.153.4 39

Quantum numbers, atomic mass numbers and atomi forces. Soonawala, M. F. *Indian J. Phys.*, **21**, 138–4 (*Aug.*, 1947).—By a simple extension of the elementar quantum theory, a relation is derived between th quantum numbers of the orbits of particles and thei atomic mass numbers. The force between the constituent of a system of atomic dimensions is derived in terms of th mass numbers of the constituents and the distance betwee them. There follows a similar derivation of the energy o the system. The application to the cases of the hydrogen-like atoms and the deuteron is considered. A.

539.154 : 537.561 : 539.153 = 3 *see Abstr.* 389

539.155.2 : 536.48 392

The separation of the isotopes He^3 and He^4 in the liquid phase. Daunt, J. G., Probst, R. E., and Johnston, H. L. *J. Chem. Phys.*, **15**, 759–60 (*Oct.*, 1947).—Earlier experiments [Abstr. 3614 (1947)] were continued, utilizing the superfluid flow through a ground glass joint, of channel width estimated to be $\sim 1\ \mu$. The He^3/He^4 ratio was reduced by a factor of 4–5, indicating that the He^3 was at least partially filtered out by flow through the channel.

539.155.2 : 541.123.59 : 541.127.2 *see Abstr.* 439

539.155.2 : 541.135 *see Abstr.* 443

539.155.2 : 621.318.572 393

A recording unit and electronic shunt selector for a mass spectrometer. Lossing, F. P., Shields, R. B., and Thode, H. G. *Canad. J. Res. B*, **25**, 397–404 (*July*, 1947).—A direct action shunt selector has been designed that pre-selects the appropriate shunt so that widely different mass spectrometer ion currents can be recorded linearly on a standard chart. In conjunction with a linear direct current amplifier and a pen recorder, this unit allows rapid and accurate recording of a given mass spectrum, which can be scanned by varying either the magnetic field or the ion accelerating potential. When used with a 180° Nier type mass spectrometer with well stabilized circuits, a precision of ±0·2% in measuring the

of CO_2^{45} and CO_2^{46} was obtained. Also, samples of ere investigated and the abundances of the isotopes mined. A.

IOACTIVITY . NUCLEAR DISINTEGRATION NUCLEAR PARTICLES 539.16/.18

6 : 578.088.5 : 541.141 *see Abstr.* 444

6.08 : 537.542 *see Abstr.* 357

6.08 : 537.542.2 394

e quantitative measurement of tritium: hydrogen-ol-argon mixtures. EIDINOFF, M. L. *J. Amer. n. Soc.*, **69**, 2504–7 (*Oct.*, 1947).—Constructional and itional details are given of a Geiger counter for the titative measurement of T in H_2–A–EtOH counting ure. The counting rate is proportional to the partial ure of the active H_2 sample in the range 10–25 mm. unting rate reproducibility of $<1\%$ was obtained. W. R. A.

6.08 : 539.166 395

e gamma-ray measurement of radium ore concentrates. ILEY, W. J., AND DIXON, W. R. *Canad. J. Res. A*, 210–22 (*July*, 1947).—A method is described for uring the Ra content of substances in which the entration is of the order of μg/g of material. The activities of the unknown material and of a standard capsule are compared by means of Geiger–Müller ters. Corrections for self-absorption and distance given for rectangular and cylindrical sources. The t of radiation scattered by the source into the detector cussed. Synthetic bulk sources made up with known tities of Ra were used for the experimental work. A.

6.08 : 771.531.1–834 396

ew photographic emulsions showing improved tracks of ing particles. DEMERS, P. *Canad. J. Res. A*, **25**, 51 (*July*, 1947).—An extension of a previous report tr. 2936 (1946)]. The tracks of ionizing particles in emulsions consist of grains of dia. $\sim 0{\cdot}2\ \mu$, which form continuous lines. Grain spacing is no longer main cause of apparent straggling, except below a e of 3 to 4 mm of air. The standard deviation in mining energy from a single measurement of range 25 to 3·5% for protons of 0·6 to 2·4 MeV, and 1·3 9% for α-rays of 4 to 8·5 MeV. Ease of finding the s, especially of protons, is considerably increased. tracks of fission fragments are easily found. Slow ron tracks have occasionally been seen. The action ertain sensitizing and desensitizing chemicals is ribed and discussed in terms of the theory of the ographic process. A quantitative theory is given for probability of development of the grains in terms of specific energy loss and a sensitivity parameter of the sion. The observed variation of the grain spacing residual range of protons, α-rays and fission frag-ts can be approximately explained by the theory. A.

162 397

method for computing transformations in radioactive s. WATSON, W. H. *Canad. J. Res. A*, **25**, 252–60 , 1947).—A direct computational procedure is given inding the coefficients of the exponential terms in the essions for the time-dependence of the amounts of the ous products in a given radioactive series. The method sed on the partition of a matrix which can be written n directly from the diagram of the series. After the anation of simple applications, an example involving le branching with 10 members of the series is con-ed in order to exhibit the generality and directness e method. A.

539.163.1 398

The growth of La^{140} (40 hours) from Ba^{140} (12·7 days). GRUMMITT, W. E., GUÉRON, J., WILKINSON, G., AND YAFFE, L. *Canad. J. Res. F*, **25**, 357–63 (*July*, 1947).—The composite self-weakening relations for La^{140} and Ba^{140} have been measured. Using these data, the growth of the La^{140} daughter from the Ba^{140} parent has been studied and compared with the growth calculated from the radioactive dependence laws. It is shown that, in the comparison of the activities of different β-emitters, there is a danger in the use of corrections obtained by extrapolations of self-weakening and external absorption data. A.

539.164.2.08 399

Scintillation counter for the detection of α-particles. SHERR, R. *Rev. Sci. Instrum.*, **18**, 767–70 (*Oct.*, 1947).—A simple battery-operated survey instrument has been developed which uses a photo-multiplier tube to detect the scintillations produced in a phosphor by α-particles. The instrument is insensitive to β- and γ-radiations. A.

539.165.2 400

The conservation of momentum in the disintegration of Li^8. CHRISTY, R. F., COHEN, E. R., FOWLER, W. A., LAURITSEN, C. C., AND LAURITSEN, T. *Phys. Rev.*, **72**, 698–711 (*Oct.* 15, 1947).—Apparatus for the introduction of radioactive materials into a cloud chamber has been employed to investigate the conservation of momentum in the β-decay of Li^8 to Be^8, which subsequently breaks up into two α-particles. The projection on the plane of measurement of the angle between the two α-particles is a measure of one component of the recoil momentum of the Be^8. Additional information is obtainable from the momentum of the electron but relatively few cases occur where both α-particles and the electron are in the plane of the cloud chamber. The Li^8 is produced by bombarding with deuterons a thin deposit of LiOH on Be or Au foils. The mean squares of the observed momenta relative to the maximum possible momenta were 0·247 (Be foil) and 0·349 (Au foil). Corrected for scattering and other errors these become $0{\cdot}197 \pm 0{\cdot}025$ and $0{\cdot}207 \pm 0{\cdot}034$, respectively, the probable errors quoted being statistical in origin. The weighted mean is $0{\cdot}20 \pm 0{\cdot}02$. This value is roughly twice that obtained taking into account only the emitted electrons, and approximately equal to that calculated for an electron and neutrino emitted with no preferred angle of ejection between them. A.

[539.166 + 537.531] : 535.33.072 *see Abstr.* 345

539.166 : 539.16.08 *see Abstr.* 395

539.166 : 539.172.1 *see Abstr.* 409

539.167.3 401

Short-lived isomeric states of Se^{83} and Ge^{77}. ARNOLD, J. R., AND SUGARMAN, N. *J. Chem. Phys.*, **15**, 703–12 (*Oct.*, 1947).—Extractions of Br from neutron-irradiated $SeO_3^=$ solutions and of As from irradiated $GeS_3^=$ solutions revealed the presence of short-lived isotopes of Se^{83} and Ge^{77} decaying by β^--emission to 2·4-hr Br^{83} and 40-hr As^{77}, respectively. Direct observation of the radiations from a short-lived Se, effected by measuring the activity of Se irradiated for 20 sec through Al absorbers, led to a $\frac{1}{2}$-life determination of 67 ± 3 sec and a β-energy of 3·4 MeV. A γ-ray was also observed. Similarly, a short-lived Ge activity was found by irradiating GeS_2 with neutrons for 20 sec and measuring the activity through Al absorbers. The $\frac{1}{2}$-life was 59 ± 2 sec and the β-energy, 2·8 MeV. The agreement between the cross-sections for formation of the 67-sec Se and the 2·4-hr Br^{83} from the short-lived Se^{83} makes it probable that the 67-sec Se is genetically related to the 2·4-hr Br^{83}. In a

like manner it was shown that the 59-sec Ge is probably identical with the short-lived Ge^{77}. The presence of these isomers resolves the difficulty of the apparently high "independent" yields of Br^{83} and As^{77} in fission. A new Se activity of $17{\cdot}5 \pm 0{\cdot}3$ sec ½-life was also found. It appears to decay by emission of γ-radiation of ~150 keV. The cross-section for formation of this activity by neutron activation of Se is $\sim 0{\cdot}6 \times 10^{-24}$ cm². A.

539.167.3 402

Artificial radioactive isotopes of polonium [and fluorine]. TEMPLETON, D. H., HOWLAND, J. J., AND PERLMAN, I. *Phys. Rev.*, **72**, 758–65 (*Nov.* 1, 1947).—Three new isotopes of Po have been prepared by bombarding isotope-enriched Pb samples with He ions, and Bi with protons and deuterons. They are: Po^{206}, 9 days, by $Pb^{204}(\alpha,2n)$; Po^{207}, 5·7 hr, by $Pb^{206}(\alpha,3n)$; Po^{208}, ~3 yr, by $Pb^{207}(\alpha,3n)$, $Bi^{209}(p,2n)$ and $Bi^{209}(d,3n)$. The 9-day Po^{206} has been shown to decay to 6·4-day Bi^{206}. No daughter activities of Po^{207} and Po^{208} have been found. No activity has been found for Po^{209}. Also 110-min $F^{18}(\beta+)$ has been prepared by the reaction $O^{16}(\alpha,pn)F^{18}$ or $O^{16}(\alpha,2n)Ne^{18} \xrightarrow{\text{short}} F^{18}$. A.

539.167.3 403

Artificial radioactive isotopes of bismuth and lead. TEMPLETON, D. H., HOWLAND, J. J., AND PERLMAN, I. *Phys. Rev.*, **72**, 766–71 (*Nov.* 1, 1947).—Six Pb and Bi activities have been identified from the bombardment of Tl, Pb and Bi with cyclotron deuterons and He ions, and of Pb with pile neutrons: Bi^{204}, 12 hr, by $Tl(\alpha,3n)$ and $Pb^{204}(d,2n)$; Bi^{206}, 6·4 day, by Po^{206} *K*-decay, $Tl(\alpha,3n)$, $Pb^{206}(d,2n)$ and $Pb^{207}(d,3n)$; Bi^{210}, 5 day by $Bi(d,p)$ and $Pb^{208}(\alpha,pn)$; Pb^{203}, 52 hr, by $Tl(d,2n)$ and $Pb^{204}(n,2n)$; Pb^{204*}, 68 min, by Bi^{204} *K*-decay and $Tl(d,3n)$; Pb^{209}, 3·3 hr, by $Pb(d,p)$ and $Pb(n,\gamma)$. No activity has been found which can be attributed to Bi^{205}, Bi^{207}, Pb^{202} or Pb^{205}, although all of these isotopes must have been produced. A.

539.172 404

Excitation of nuclei by electrons. TOUSCHEK, B. *Nature, Lond.*, **160**, 500 (*Oct.* 11, 1947).—Cross-sections corresponding to observed values [Abstr. 118 (1940)] are calculated on the assumption of an inelastic collision mechanism, based on electro-magnetic interaction between the electrons and the protons of the bombarded nucleus.

539.172 405

Note on angular distributions in nuclear reactions. EISNER, E., AND SACHS, R. G. *Phys. Rev.*, **72**, 680–1 (*Oct.* 15, 1947).—A proof is given of the physically plausible theorem that in a nuclear reaction produced with an unpolarized beam of given orbital angular momentum incident on an unpolarized target, the angular distribution of the outgoing intensity cannot be more complicated than that of the incoming intensity. A.

539.172 = 4 406

Disintegration of the Be^9 nucleus by fast electron impact. CALDIROLA, P. *J. Phys. Radium* (*Sér.* 8) **8**, 155–60 (*May*, 1947) *In French.*—The theory is worked out by treating the process as a transition from a stationary state to a state in the continuum of the system (Be^8 + neutron). Interactions of the incident electron with the electric and magnetic dipole moments of the system are considered; the latter is important only for energies near the threshold. The calculated curve of cross-section *v.* energy agrees well with experiment [Abstr. 1690 (1946)]. A. P. F.

539.172 : 537.591 407

Nuclear explosion recorded by photographic emulsion method. ROY, R. R. *Nature, Lond.*, **160**, 498 (*Oct.* 11, 1947).—22 particles, all of them probably proto were ejected in the explosion, caused by cosmic rays sea level, which originated in a mica sheet above the phot emulsion. A rough estimate of the energy involved giv a minimum figure of 250 MeV.

539.172 : 539.152.1 4

Nuclear reactions at high energies. SERBER, R. *Ph Rev.*, **72**, 1114–15 (*Dec.* 1, 1947).—Consideration is giv to the behaviour of high energy particles on striking nucleus. Because of their speed their interaction wi a nucleus may be regarded as an interaction with one or of the nucleons but this nucleon cannot be regarded free, as the momentum transfer to it at collision is n ⩾ the characteristic momentum of particles in t nucleus. This leads to an increase, by a factor of 5/3, the mean free path in the nucleus of the bombardi particle. From these considerations it is estimated th the mean free path of a 100 MeV bombarding nucle $\simeq 4 \times 10^{-13}$ cm and its energy transfer to a struck nucle particle $\simeq$ 25 MeV. The fate of the bombarding parti will depend on its collision parameter; if it passes throu the periphery of the nucleus it will pass out with its ener reduced by ~25 MeV. If it passes through the centre may make several collisions and lose most of its energ The results of these general considerations are then d cussed in terms of excitation curves and total cros sections for scattering and absorption. W. E.

539.172 : 539.18 *see Abstr.* 421

539.172.1 : 539.166 4

Gamma-ray yield curves of separated neon isotop bombarded with protons. BROSTRÖM, K. J., HUUS, T AND KOCH, J. *Nature, Lond.*, **160**, 498–500 (*Oct.* 1 1947).—Stable Ne targets about 100 atoms thick we prepared by collecting 60 keV ion beams on Ag discs a mass spectroscope. Techniques of *p* bombardment ar γ-ray detection were as previously used for Al [Abs 2238 (1947)] and the energy range investigated was t same. A number of resonance peaks were recorded ar attributions are made; in the case of Ne^{22} about 20 pea were recorded in considerable detail, the radiation widt being estimated at ~20 eV.

539.172.3 4

Photo-disintegration of the deuteron. GIBSON, W. M GREEN, L. L., AND LIVESEY, D. L. *Nature, Lond.*, 16 534–5 (*Oct.* 18, 1947).—Nuclear research photograph emulsions containing about 6% by weight of D_2O we exposed for 5 hours to 6 MeV γ-rays arising fro 0·95 MeV protons on F (NaF). Sixty proton trac due to photo-disintegration of D, at angles of 70–180° the γ-ray beam, were identified and the distribution angle was plotted. Between these angles it follows t law $f(\theta)d\theta = k \sin^2\theta d\theta$ [$f(\theta)$ = protons/unit solid ang emitted at angle θ to γ-ray beam] [Abstr. 2929 (1936)].

539.172.3 : 537.133 4

High energy photo-disintegration of the deuter ROSE, M. E., AND GOERTZEL, G. *Phys. Rev.*, **72**, 749– (*Nov.* 1, 1947).—The disintegration of the deuteron b γ-rays in the range 50–250 MeV is investigated. It shown that at the high radiation energies considered it essential to take into account the range of the nucle forces in the ground state, because of the importance interference effects (short de Broglie wavelength of t nucleons) which depend very strongly on the "size" the deuteron. The cross-section at 50 MeV is 37 μ $(37 \times 10^{-30}$ cm²) and decreases with γ-ray energy up t 150 MeV as $(\hbar\omega)^{-n}$ where *n* lies between 4 and 5. Beyon 150 MeV the cross-section decreases less rapidly becau of a more favourable phase relation between outgoin waves from different parts of the deuteron. The gener

tures of the cross-section and of the angular distribution of the particles can be understood in terms of interference; the most important effect is to favour strongly all momentum for the recoil particle (proton in the case charge coupling and both proton and neutron in the e of spin coupling). The error caused by neglect of clear forces in the final state is estimated, by a consideration of electric dipole transitions, to be <30% in the rst case (low energy photons). The effects of retarda- n and higher multipoles are calculated explicitly; these cts are small at 50 MeV and important at 100 MeV. is also shown that the effect of non-central forces ween the nucleons in the ground state introduces gligible error. A.

9.172.4 412

The fission yields of Ba^{139} and Ba^{140} in neutron fission of U^{235} and U^{238}. GRUMMITT, W. E., GUÉRON, J., WILKINSON, G., AND YAFFE, L. *Canad. J. Res. B*, **25**, 364–70 (*July*, 1947).—The yields for thermal fission of U^{235} and fission of U^{238} have been measured using naturally occurring U, by comparing the Ba fission product activities with the U^{239} formed in radiative capture. They were found to be 6·1% and 5·6% for Ba^{139} and Ba^{140}, respectively, for thermal fission and 5·1% and 2% for Ba^{139} and Ba^{140}, respectively, for fast fission. The contribution of resonance fission to the thermal neutron effect has been shown to be <5% in the irradiation arrangement used. A.

9.172.4 413

Fission yields of masses 131, 132, 134, and 136 formed in neutron fission of uranium. YAFFE, L., AND MACKINTOSH, J. E. *Canad. J. Res. B*, **25**, 371–5 (*July*, 1947).—The ratio of I^{131} (8 days) to Ba^{140} has been determined and the yield of the former calculated to be $2{\cdot}23\times10^{-2}$. This in turn permits the estimation of fission yields for the 132, 134, and 136 fission chains [Abstr. 1931 (1947)]. The ratio of 54-min I to Ba^{139} has been determined, and the yield for I was found to be $5{\cdot}75\times10^{-2}$. A mass of 134 is assigned to the 54-min I. A.

539.172.4 414

Peaceful applications of nuclear fission. COCKCROFT, J. D. *Nature, Lond.*, **160**, 451–3 (*Oct.* 4, 1947).—A report of a symposium, being chiefly an account of the starting of the graphite low-energy pile at Harwell, England, and the programme of work laid out for it, in nuclear research and the production of radioactive isotopes.

539.172.4 = 3 415

Investigation of the (n,α)-reaction of chlorine by means of an ionization chamber that can be heated. METZGER, F., HUBER, P., AND ALDER, F. *Helv. Phys. Acta*, **20** (*No.* 3) 136–7 (1947) *In German.*—The ionization work of CCl_4 is 26·8 ± 1·0 eV. The reaction energy for irradiation with D–D neutrons was determined with CCl_4 vapour in a heated ionization chamber to be 3·42 ± 0·20 MeV, and the energy of the corresponding (n,α)-process is 0·44 ± 0·20 MeV. This must be ascribed to the reaction $Cl^{35}(n,\alpha)P^{32}$. According to the mass values of these isotopes the energy of this reaction should be 1·1 MeV so that the α-group investigated in this work must refer to an excited state of P^{32}. The effective cross-section is $1{\cdot}7\times10^{-26}$ cm². A. J. M.

539.172.4 : 539.185.7 416

Resonance phenomena in the interaction of fast neutrons with beryllium and aluminium. ALLEN, K. W., BURCHAM, W. E., AND WILKINSON, D. H. *Proc. Roy. Soc. A*, **192**, 114–27 (*Dec.* 23, 1947).—The total scattering cross-sections of Be and Al were measured by a transmission method for neutrons of energies between 0·35 and 0·55 MeV and 1·8 and 4·0 MeV. Resonances were found in the scattering by Be at a neutron energy of 2·6 MeV and by Al at energies of 2·4 and 2·9 MeV. It has been shown that the cross-section for the reaction Be^9 (n,α) He^6 also has a resonance at 2·6 MeV, and an accurate determination of the cross-section for this reaction has been made. A discussion is given of the properties of the energy level in Be^{10} responsible for the resonances in the case of Be. A.

539.18 : 537.591 417

Observations on the tracks of slow mesons in photographic emulsions. I. Existence of mesons of different mass. LATTES, C. M. G., OCCHIALINI, G. P. S., AND POWELL, C. F. *Nature, Lond.*, **160**, 453–6 (*Oct.* 4, 1947).—Boron-loaded Nuclear Research plates exposed at 5 500 m showed 40 examples of production of secondary mesons (μ-mesons) [Abstr. 2237 (1947)]; in 11, the μ-mesons came to rest within the emulsion, and the tracks could be measured. The range in the emulsion of the μ-mesons was remarkably uniform, indicating the occurrence of a fundamental process, for which the term *μ-decay* of primary (π) mesons to μ-mesons is proposed. The π/μ mass-ratio is estimated to be ~ 2, which is shown to be only possible if the momentum-balancing particle emitted in the decay is of mass comparable with the μ-meson. The event is shown to be quite a common one for cosmic ray mesons.

II. Origin of the slow mesons. *Ibid.*, 486–92 (*Oct.* 11, 1947).—The origin of the slow mesons observed in photographic emulsions is discussed, and their relation to the fast mesons forming the penetrating cosmic ray component. Photomicrographs are given, showing that some of the slow mesons ejected from nuclei during "explosive disintegration" can enter nuclei and produce a second disintegration; such mesons are provisionally called σ-mesons, and are presumed to be negatively charged. Explosive disintegrations possibly also produce π-mesons, and it is believed that these mesons are the positively-charged counterpart of σ-mesons. It appears likely that the greater part of the mesons observed at sea level are μ-mesons arising from decay of π-mesons; and both positive and negative π-mesons have a short life of 10^{-6} to 10^{-11} sec. See Abstr. 421 (1948).

539.18 : 537.591.1 *see Abstr.* 363

539.18 : 537.591.1 418

On the mass and the disintegration products of the mesotron. ANDERSON, C. D., ADAMS, R. V., LLOYD, P. E., AND RAU, R. R. *Phys. Rev.*, **72**, 724–6 (*Oct.* 15, 1947).—A photograph has been obtained of a mesotron of positive charge which comes to rest in the gas of a cloud chamber and ejects a positron of 24-MeV energy. Several possible interpretations of this photograph are discussed. A.

539.18 : 537.591.3 419

The radioactive decay of slow positive and negative mesons. VALLEY, G. E. *Phys. Rev.*, **72**, 772–83 (*Nov.* 1, 1947).—Cosmic ray mesons, after passage through a cloud chamber situated in a magnetic field, were slowed down and allowed to decay in specimens of C, stainless steel, brass, water and Be. By means of delayed coincidence circuits the cloud chamber was actuated only when a meson decayed in the specimen. In stainless steel and in brass, only + mesons decay; in C, water, and Be both + and − mesons decay in such numbers as to indicate that few, if any, of the − mesons undergo nuclear capture in these substances. It is shown that the masses of the decaying mesons are $\sim 200\times$ the mass of an electron. A.

539.18 : 537.591.3 = 5 420

On the retardation of fast particles. WICK, G. C. *Nuovo Cim.*, **1**, 302–13 (*June*, 1943) *In Italian.*—The

theory of the density-effect on the stopping power for fast particles is discussed, and the magnitude of the effect is calculated for Fe and graphite. The range-energy relation for mesons in these substances is calculated and the results, and those for air, water, and Pb, are given in the form of a nomogram. G. P. S. O.

539.18 : 537.591.3 = 5 *see Abstr.* 367

539.18 : 539.172 421

Hypothetical alternative energy sources for the "second meson" events. FRANK, F. C. *Nature, Lond.*, **160**, 525–7 (*Oct.* 18, 1947).—The following alternatives to the suggestion of Lattes *et al* [Abstr. 417 (1948)] for the generation of 4 MeV at the end of a meson track are considered, and rejected, bearing in mind the chemical constitution of the photo emulsion: induced β- or K capture processes; induced emission of single nucleons; induced α-emission; induced fission; processes with change of charge of 2, by conversion of neg. to pos. meson; induced decay of naturally persisting nuclear isomers. Processes involving the addition of a proton to some other nucleus are discussed at length; these might take place through the intermediate formation of a "mesonic hydrogen atom" by the meson entering a hydrogen-like orbit round a proton. It is concluded that the latter process, though possibly operative in nuclear reactions, is not responsible for the observations of Lattes *et al*, and their explanation remains the only feasible one.

539.185 422

A theorem on neutron multiplication. PLACZEK, G., AND VOLKOFF, G. *Canad. J. Res. A*, **25**, 276–92 (*July*, 1947).—The asymptotic behaviour of the neutron distribution due to a point source in an ∞ homogeneous medium in which a convergent chain reaction (multiplication constant $k < 1$) takes place is investigated without special assumptions about the properties of the medium and the mechanism of neutron diffusion. It is shown under very general assumptions that at large distances r from the point source the distribution always has the form $(A/r)\exp(-\mu r)$. General expressions for the constants μ and A of this asymptotic form of the distribution are given for any $k < 1$ in terms of the Fourier transform of the spatial distribution of primary fission neutrons. These expressions reduce to particularly simple form for $(1 - k) \ll 1$. The exact expression for the neutron distribution throughout the medium is given in integral form. Four special frequently occurring cases are discussed as illustrations of the general result. A.

539.185 : 537.542 423

A neutron detector having uniform sensitivity from 10 Kev to 3 Mev. HANSON, A. O., AND MCKIBBEN, J. L. *Phys. Rev.*, **72**, 673–7 (*Oct.* 15, 1947).—The arrangement, known as a long counter, consists of a paraffin cylinder about 10 in outer dia. ×12 in long surrounding a long BF_3 proportional counter. Sensitivity curves are given for two of the best arrangements. The response is flat over the range to ~10%. A.

539.185.08 : 537.542 *see Abstr.* 358

539.185.7 424

Ratio of neutron absorption cross-sections of boron and hydrogen. WHITEHOUSE, W. J., AND GRAHAM, G. A. R. *Canad. J. Res. A*, **25**, 261–75 (*July*, 1947).—Using a Ra–α–Be source and a small BF_3 chamber as detector, the ratio has been measured by the integration method in water and in aqueous solutions of boric acid to be 2 270, with a statistical error of ±30. Subsidiary experiments have been made which fix at ~3% the upper limit of the systematic error caused by perturbation of the neutron density in the neighbourhood of the ionizati chamber.

539.185.7 : 539.172.4 *see Abstr.* 416

539.185.9 = 4 4

Action of slow neutrons on bromine ions in soluti SÜE, P., AND MELANDER, L. *C.R. Acad. Sci., Paris*, 2 413–15 (*Sept.* 1, 1947) *In French.*—Br ions (aqueo ammonium bromide) were irradiated with slow neutro under conditions which would permit any neutral formed to react with phenol, and a small quantity of was found to be fixed by the phenol, but only at t moment of capture of a neutron. There was no eviden of a photo-chemical reaction $\propto$ time liberating inacti Br. Two explanations are proposed, either molecular is formed and reacts at once with phenol, or radioacti Br ions are formed in an excited state which enabl them to react. C. B.

539.185.9 : 537.56 4

Small boron chambers for slow neutron measuremen VEALL, N. *J. Sci. Instrum.*, **24**, 331–2 (*Dec.*, 1947). An account of the design and construction of small BF filled ionization chambers (vol. $\leqslant 0{\cdot}5$ cm³) and their u for counting neutrons. The procedure for filling eliminat difficulties due to contamination of the insulator surfa and allows accurate control over the sensitivity of t chambers. Applications and the corresponding co structional modifications are discussed.

STRUCTURE OF SOLIDS 539.2

539.215 : 538.221 *see Abstr.* 370

539.215.2 : 548.53 : 539.389.3 *see Abstr.* 431–2

539.215.6 : 548.23 *see Abstr.* 453

539.23 : 532.64 *see Abstr.* 251

539.26 : 545.824 *see Abstr.* 450

ELASTICITY . STRENGTH . RHEOLOGY 539.3/

539.32 : 534.845 = 3 *see Abstr.* 275

539.32.096 : 534.112 = 4 42

Measurement of Young's modulus and its variation wi temperature. Use of an acoustic transmission wi FLORISSON, C. *C.R. Acad. Sci., Paris*, **223**, 18–20 (*July* 1946) *In French.*—An experimental method is brief described which may be used to investigate the variatic of the modulus of various steels up to 800°C and vario types of brass up to 460°C. L. S.

539.374 42

The flow of metals at elevated temperatures. I–I HOLLOMON, J. H., AND LUBAHN, J. D. *Gen. Elect. Re* **50**, 28–32 (*Feb.*); 44–50 (*April*, 1947).—Derives a gener equation relating stress, strain, strain rate and ten perature in plastic flow of metals under simplified co ditions, from which the complete creep behaviour coul be determined from the results of a small number tensile tests. Supporting experimental evidence presented for a wide range of conditions. The equatio is regarded as a mechanical equation of state, its for being independent of past history in absence of phas changes. G. O.

539.374 42

A connexion between the criterion of yield and the strai ratio relationship in plastic solids. TAYLOR, G. *Pro Roy. Soc. A*, **191**, 441–6 (*Dec.*, 1947).—The assumptio that the work done during a small plastic strain is a ma as the yield-stress criterion is varied is shown to give ris

connection between the yield-stress and the strain- relationship. The strain-ratio relationship is that ch exists between the ratios of principal stress rences and the ratios of the corresponding strain rences. It is common to assume that this relationship ne of simple proportionality. Experiments, however, w that this assumption is not true in metals. The rved strain-ratio relationship is used in conjunction the assumption of max. work during a given strain alculate the criterion of yield. It is found that this is close to, but not identical with, the Mises-Hencky rion. A.

.387 : 621.771 430

n the possibility of increasing the elongation per pass olling non-ferrous metals. GUBKIN, S. I., ISTOMIN, S., AND PERLIN, I. L. *C.R. Acad. Sci. URSS*, **52** . 7) 585–8 (1946).—A study of deformability was e on Zn and Cu. The max. principal strain at which re occurs under various stress states was determined different rates of deformation, Zn being investigated he temp. range, 20 to 400°C and Cu in the range 20 to °C. Conclusions are: (1) The max. principal strain ier which Zn fails is greatly increased on passing from sion to open compression; (2) failure of Cu takes place y in tension; (3) in rolling the reduction per pass may increased considerably as compared with reductions v used. L. S. G.

.389.3 : 539.215.2 : 548.53 431

tecovery and recrystallization viewed as processes of olution and movement of dislocations. III. Dissolution movement of dislocations during heat treatment. RGERS, W. G. *Proc. K. Ned. Akad. Wet.*, **50** (*No.* 7) 1–30 (1947).—See Abstr. 2658–9 (1947). The micro- pic process corresponding to macroscopic recovery is mutual dissolution of dislocations of opposite sign, ompanied by the displacement of groups of dislocations the same sign to positions where they minimize the ice stress. Further decrease of lattice stress must be by boundary movement, which is a process of grain growth (recrystallization). Boundaries between crystals having nearly the same orientation are particularly stable. The processes of grain growth in Al sheet are discussed. A. J. C. W.

539.389.3 : 539.215.2 : 548.53 432

Recovery and recrystallization viewed as processes of dissolution and movement of dislocations. Occurrence of "stimulated" crystals. BURGERS, W. G. *Proc. K. Ned. Akad. Wet.*, **50** (*No.* 8) 858–61 (1947).—The observations of Sandee [Abstr. 3319 (1947)] on stimulated crystals explain the increase with time of the rate of nucleus formation in rolled Al sheet [Anderson and Mehl, *Amer. Inst. Min. Met. Engrs, Tech. Publ.*, 1805 (1945)]. A. J. C. W.

539.4.011 : 539.4.016.3 433

Thermal hardening of cadmium crystals. SMITH, C. L. *Nature, Lond.*, **160**, 466–7 (*Oct.* 4, 1947).—Appreciable raising of the critical yield stress of Cd crystals after a few hours annealing at room temp., or correspondingly less at higher temps., is reported [see Abstr. 619 (1940)]. The amount of hardening was found to depend materially on the angle between the applied stress and the glide direction, being virtually zero for 40°–45° inclination, and rising rapidly on each side of this minimum.

539.4.011.25 434

The time effect in the fracture of glass and other materials. SAIBEL, E. *J. Chem. Phys.*, **15**, 760–1 (*Oct.*, 1947).—The problem is treated from the point of view of chemical reaction rate theory, taking account of the rate at which external loads are applied, and the effect of the breaking of bonds upon the remaining ones. The relationship $t = (1/Br) \log Fr$ is obtained between time to fracture, t, and rate of loading, r; (F and B are temp.-dependent constants).

539.4.016.3 : 539.4.011 *see Abstr.* 433

539.893 : 621.51 : 533.21 *see Abstr.* 256

PHYSICAL CHEMISTRY 541

.1 : 536.7 *see Abstr.* 320

PHASE EQUILIBRIUM 541.121/.123

1.123.59 : 539.155.2 : 541.127.2 *see Abstr.* 439

REACTION KINETICS 541.124/.128

1.126 435

Dissociation and unreleased energy in carbon-monoxide plosions. LEAH, A. S. *Phil. Mag.*, **38**, 301–16 (*May*, 47).—The unreleased energy depends upon (1) the tial pressure, (2) the nature of the diluent gas, and the size of the explosion vessel, and is due to latent ergy and abnormal dissociation. L. S. G.

1.126 : 534.222.2 : 533.6.011.4 *see Abstr.* 259

1.126 : 536.71 436

The hydrodynamic theory of detonation. I. On the rmochemistry and equation of state of the explosion oducts of condensed explosives. MORRIS, G., AND HOMAS, H. *Research, Lond.*, **1**, 132–44 (*Dec.*, 1947).— he thermochemical parameters, i.e. the heat and tem- rature of explosion, specific volume of the gaseous plosion products, and the pressure of explosion, are fined for modern blasting explosives, and the funda- ntal thermochemical data required for their calculation esented. A systematic method has been developed for the calculation of these parameters for nearly oxygen-balanced compositions, while the more specialized treatment required for strongly oxygen-negative compositions is briefly outlined. Current knowledge on the equation of state for gases at high temperature and pressure is briefly reviewed, and a suitable equation of state selected for application to detonation phenomena. A.

541.127.1 : 541.144 437

Kinetics of the photolysis of methyl iodide and the hydrogen halides. I. Photolysis of hydrogen iodide in the presence of iodine, hydrogen bromide and hydrogen chloride. WILLIAMS, R. R., JR., AND OGG, R. A., JR. *J. Chem. Phys.*, **15**, 691–6 (*Oct.*, 1947).—The photo-dissociation of HI by light of $\lambda 2537$ Å has been utilized as a source of H atoms for a study of their subsequent reactions with I_2 and the hydrogen halides. The observed rate of H formation has been used to evaluate the ratio of rate constants for the reactions $H + HX \rightarrow H_2 + X$ and $H + I_2 \rightarrow HI + I$ where X represents Cl, Br or I. A.

541.127.1 : 541.144 438

Kinetics of the photolysis of methyl iodide and the hydrogen halides. II. Photolysis of methyl iodide in the presence of iodine and the hydrogen halides. WILLIAMS, R. R., JR., AND OGG, R. A., JR. *J. Chem. Phys.*, **15**, 696–702 (*Oct.*, 1947).—The photodissociation of MeI by light of $\lambda 2537$ Å has been utilized as a source of Me

radicals for a study of their subsequent reactions with I and the hydrogen halides. The observed rate of methane formation has been used to evaluate the ratio of rate constants for the reactions: $CH_3 + HX \rightarrow CH_4 + X$ and $CH_3 + I_2 \rightarrow CH_3I + I$ where X represents Cl, Br or I. The reaction with HCl has been found to be complicated by the unequal yield of CH_4 and I, and possible explanations of this phenomenon have been considered. A.

541.127.2 : 541.123.59 : 539.155.2 439

On the kinetic application of the law of mass action. BAYLISS, N. S., AND ELLIOTT, G. A. *Phil. Mag.*, **38**, 683–4 (*Sept.*, 1947).—A difficulty in a previous paper [Abstr. 689 (1947)] is discussed and the kinetic derivation of the equilibrium constant in an exchange reaction of the type $A_2 + B_2 = 2AB$, where A and B are two isotopic atomic species, is illustrated by means of an example. L. S. G.

ELECTROCHEMISTRY 541.13

541.132 : 532.72 440

Measurement of Na^+ ion diffusion by means of radio-sodium. ADAMSON, A. W. *J. Chem. Phys.*, **15**, 762–3 (*Oct.*, 1947).—The diffusion was measured in sintered-glass diaphragm cells, the upper compartment being filled with NaI solution containing 3-yr Na^{22}, and the lower plain NaI solution. The relation $D(cm^2/day) = 1{\cdot}16\ (1\text{–}1{\cdot}41c^{\frac{1}{2}})$; ($D$ = self-diffusion coeff., c = conc.).

541.134 441

Some observations on decomposition voltages. BOCKRIS, J. O'M., AND IGNATOWICZ, S. *Trans. Electrochem. Soc.*, **92** (*Prepr. No.* 9) 115–22 (1947).—The classical theory of the "residual current" is rejected, particularly as applied to solutions of heavy metal salts. It is suggested that in such cases the residual current is due to the discharge of H ions rather than metal ions. The discharge potentials of the tetra-alkyl NH_4 ions from CH_3 to C_5H_{11} have been determined and, in general, found to increase with an increase in the number of C atoms. The decomposition voltages of $ZnCl_2$, $HgBr_2$, $CdBr_2$ and $AgNO_3$ in pyridine have been determined and compared with those obtained in aqueous solution. Existence of a complex Ag anion is indicated. A.

541.134 : 620.193.3 442

The overvoltage of oxygen ionization and its rôle in corrosion processes. TOMASHOV, N. D. *C.R. Acad. Sci. URSS*, **52** (*No.* 7) 601–4 (1946).—Apparatus for studying the overvoltage is described. The current strength of a cathode–Zn couple in a 3% solution of NaCl in a steady state was measured for cathodes of various materials. The overvoltage depends logarithmically upon the density of the cathode current, and is much greater than the overvoltage of hydrogen evolution. L. S. G.

541.135 : 539.155.2 443

The cathodic protium–tritium separation factor. I. Apparatus; platinum cathode–alkaline solution. EIDINOFF, M. L. *J. Amer. Chem. Soc.*, **69**, 2507–9 (*Oct.*, 1947).—Separation factors of 13·4 and 14·7 have been obtained in the electrolysis at 20°c of 10% NaOH at a smooth Pt cathode with a current density of 0·1 A/cm². The construction and manipulation of the electrolysis cell and electrode gas lines are given. W. R. A.

PHOTOCHEMISTRY 541.14

541.141 : 539.16 : 578.088.5 444

Some aspects of the chemical and biological action of radiations. WEISS, J. *Trans. Faraday Soc.*, **43**, 314–24 (*June*, 1947).—The simple hypothesis put forward by the author [Abstr. 296 (1945)] to explain the chemical a of ionizing radiations in solution has been devel further and applied to some biological effects of radia in aqueous media. The direct and indirect actio radiations, the formation, action and the implicatio free radicals and the relation to the physical "hit" th have been discussed in detail. It is found that recombination process following the primary form of the radicals is of considerable importance. I combination can be neglected the effects are approxim independent of the nature and wavelength of the radia and depend only on the total dose, while this is no lo the case if the recombination process plays a part.

541.144 : 541.127.1 *see Abstr.* 437–8

541.144.7 : 581.035

Quantum efficiency in photosynthesis. GABRIEL E. K. *Experientia*, **3** (*No.* 11) 439–42 (1947).—Accor to the thermodynamic equation for photosynthesis, quantum yield in the reduction of CO_2 during radia with the least quanta within the photosynthetic spect from λ300 to 700 mμ is at the most $k = 0{\cdot}34$ [k = nur of molecules converted per absorbed quantum (quar efficiency)]. Calculation shows that at least 3 qu are needed for the reduction of one molecule of C Warburg and Negelein found $k = 0{\cdot}23$ from experim with monocellular green algae (*Chlorella vulgaris*), concluded that 4 quanta were required. Other ex ments gave values of k between 0·04 and 0·14. present author now reports k values $< 0{\cdot}23$, and *Sinapis-*, *Corylus-*, *Fraxinus-* and *Phaseolus-* leaves, k values lie between 0·08 and 0·09. These re indicate that 12 quanta are required for the conver of one CO_2 molecule, corresponding to $k = 0{\cdot}083$. H. H.

COLLOIDS . DISPERSE SYSTEMS 541.18/

541.182.3.08 : 535.434

A photoelectronic counter for colloidal parti GUCKER, F. T., JR., O'KONSKI, C. T., PICKARD, H. AND PITTS, J. N., JR. *J. Amer. Chem. Soc.*, **69**, 2422 (*Oct.*, 1947).—The construction and operation o photoelectronic counter are given. It utilizes the fla of light scattered by colloidal particles traversing a s space under dark-field illumination. Its practical ra is 3–2 000 counts/min, although at present some parti are missed. Tests have been made with uniform dic phthalate (I) aerosols of diameter down to 0·6 μ and aerosols of ellipsoidal spores of *B. globigii*. Tests respirator filters using concentrated aerosols of (I) a sensitivity of 10^{-8} %. W. F

ADSORPTION 541.183

541.183.1 : 532.696.1 : 532.612.4 *see Abstr.* 250

CHEMICAL STRUCTURE 541.4/.6

541.57

Remarks on the structure of carbon monoxide. LO L. H., AND WALSH, A. D. *Trans. Faraday Soc.*, 342–51 (*June*, 1947).—It is shown that arguments fo "triple bond" structure of carbon monoxide are not va An alternative resonance description is critici Evidence mainly from (*a*) the dependence of carbo properties on bond polarity, (*b*) Rydberg series, (*c*) c parison of the processes $CO \rightarrow (CO)^+$ and $N_2 \rightarrow$ is then given in favour of a "double bond" structure CO. Some objections are briefly discussed and a sim

of improving the representation of carbonyl compds suggested. A.

7 : 535.343 : 539.132 *see Abstr.* 381

7 : 535.343.4–14 *see Abstr.* 295

7 : 539.132 *see Abstr.* 382

7 : 539.153 *see Abstr.* 390

7 : 538.224 448

e diamagnetic susceptibility of some aliphatic acids esters. FRENCH, C. M. *Trans. Faraday Soc.*, **43,** 64 (*June*, 1947).—24 mono- and di-carboxylic acids esters have been measured and are recorded. An mination is made of various possible causes of tion in the molar susceptibility increment, and the retically calculated magnitude of certain of these ts is noted. The magnitude of the possible error in molar susceptibility, and hence the accuracy of the vation of the CH_2 increment in the higher members ve series is discussed, and an alternative method of mination of results is suggested. A.

CHEMICAL ANALYSIS 543/545

545.71 : 545.82 : 535.343.4–15 449

Selective infra-red gas analyzers. FASTIE, W. G., AND PFUND, A. H. *J. Opt. Soc. Amer.*, **37,** 762–8 (*Oct.*, 1947).—A summary of infra-red methods of gas analysis is presented. The experimental work which led to the development of an instrument for service applications is described. The properties of this final instrument are outlined, together with a resume of performance characteristics for a number of applications. A.

545.82 : 535.343–15 *see Abstr.* 292

545.82 : 535.343.4–15 : 545.71 *see Abstr.* 449

545.824 : 539.26 450

Quantitative analysis of mixed powders with the Geiger-counter X-ray spectrometer. WILCHINSKY, Z. W. *J. Appl. Phys.*, **18,** 929 (*Oct.*, 1947).—A simple expression is developed relating the weight fraction of a crystalline component to experimental quantities in the presence of other components which may be crystalline or amorphous, identified or unidentified. A.

CRYSTALLOGRAPHY 548

0 : 535.68 451

he decoloration of natural fluorite crystals. HERMAN, AND SILVERMAN, S. *J. Opt. Soc. Amer.*, **37,** 871–2 ., 1947).—The simple heat treatment for decolouring rite crystals of various hues is described. The rovement in transmittance is shown by means of trophotometer curves. A.

1 452

alculation of the stereographic pole figure of the cubic ice for any given direction. MAY, W. *Proc. K. Ned. ad. Wet.*, **50** (*No.* 5) 548–53; (*No.* 6) 626–39 (1947).—Earlier methods of construction of cubic pole ures have an accuracy of at best 1%. Analysis ws that the rectangular co-ordinates of the pole (*hkl*) when (*HKL*) is the plane of projection $x = P(Hk - Kh)\sqrt{(H^2 + K^2 + L^2)}$ and $y = H(Hl - Lh) + K(Kl - Lk)\}$ where P is the radius of reference circle divided by $\{Hh + Kk + Ll + H^2 + K^2 + L^2).\sqrt{(h^2 + k^2 + l^2)}\}.\sqrt{(H^2 + K^2)}$. The ition of the pole can thus be determined with any ired accuracy. II. Tables of x and y to the nearest 1 cm are given for a circle of reference of radius cm, $HKL = 110$, 001, 112, 130, 111, and *hkl* the e-centred cubic reflections up to $h^2 + k^2 + l^2 = 56$.
A. J. C. W.

3.23 : 539.215.6 453

Crystalline aggregation of cobalt powder. MCCARTNEY, T., AND ANDERSON, R. B. *J. Appl. Phys.*, **18,** 902–3 ct., 1947).—In electron microscopic studies of Fischer–opsch catalysts, an interesting phenomenon was served in Co metal powder reduced from cobaltous ide. The oxide particles sintered into larger smooth oplets of Co that were aggregated into thin hexagonal-aped platelets. X-ray diffraction analysis showed the esence of the hexagonal crystal phase of Co. A ssible explanation is that the aggregates are formed by rces similar to those operating in normal crystal rmation, but of reduced magnitude insufficient to stroy the identity of the component particles. A.

8.53 : 539.215.2 : 539.389.3 *see Abstr.* 431–2

8.73 : 536.413 : 669.215.3 454

The thermal expansion of the gold–copper alloy $AuCu_3$. WEN, E. A., AND LIU, Y. H. *Phil. Mag.*, **38,** 354–60 *May*, 1947).—The expansion was firstly investigated with a fibre X-ray camera, in the temperature range 200–620°C. The focusing camera was used to study more fully the expansion in the range 300–400°C. A table of values of the lattice parameter, in the range 0–620°C is given. It is suggested that the size of the crystals of the ordered lattice may have an effect upon the value of the thermal coefficient. L. S. G.

548.73 : 549.211 455

Inequality of (111) X-ray reflexions in diamond. WOOSTER, W. A., AND MACDONALD, G. A. *Nature, Lond.*, **160,** 500 (*Oct.* 11, 1947).—Reflections from three (111) planes in turn were measured on an ionization spectrometer as a crystal was rotated. The integrated values for each plane was measured; the three were not exactly equal. This indicates that the crystal imperfections producing the anomalous streaks [Abstr. 1090 (1942)] are not distributed with cubic symmetry.

548.734.3 : 621.365.41 456

A furnace for high-temperature X-ray powder cameras. ALCOCK, T. C., PEISER, H. S., PONT, J. S., AND SWALLOW, H. T. S. *J. Sci. Instrum.*, **24,** 297–8 (*Nov.*, 1947).—A small radiation furnace is described for use in a high-temperature vacuum X-ray camera of the Owen type. The chief features of this furnace are uniformity of temperature and small surface area which render the furnace suitable for high vacuum work. A.

548.736.34 : 669.215.3 457

Superlattice formation. OWEN, E. A., AND SIM, G. MCA. *Phil. Mag.*, **38,** 342–54 (*May*, 1947).—Experimental measurement of the intensity of the superlattice lines of the alloy $AuCu_3$ in relation to the intensity of the main-lattice lines is made. The variation of the size of the nuclei with the period of annealing at a given temperature is investigated. The growth of the nuclei is also studied. Results of Sykes [Abstr. 4475 (1936)] are confirmed. L. S. G.

548.736.34 : 669.215.3 458

Diffraction of X-rays by the alloy $AuCu_3$. EDMUNDS, I. G., HINDE, R. M., AND LIPSON, H.; WILSON, A. J. C. *Nature, Lond.*, **160,** 304–5 (*Aug.* 30, 1947).—(1) The superlattice reflections occurring in single-crystal oscillation photographs of partly ordered $AuCu_3$ are extended parallel to certain axes, the direction of the extension varying systematically with the indices. This behaviour

548.737

is not in accord with the theory of MacGillavry and Strijk [Abstr. 2697 (1946)], whose experiments were not designed to observe it. (2) The distribution of intensity of reflection in reciprocal space is the Fourier transform of the mean value of the product FF* for two cells separated by the translation x, y, z. If in the "mistakes" in the $AuCu_3$ lattice the Au atoms tend to avoid one another [Abstr. 2363 (1943)] the distribution obtained is in qualitative agreement with the expts reported above and in semi-quantitative agreement with those of MacGillavry and Strijk. A. J. C. W.

548.737 459

On the synthesis of native proteins. WRINCH, D. M. *Phil. Mag.*, **38**, 373–98 (*June*, 1947).—A possi mechanism is proposed for the autosynthesis of prote (units of native proteins). This arises from a study data obtained in the X-ray structure analysis of cert molecular crystals. It implies a certain structure proteons, and this structure explains the "explosic theory of protein cleavage. Other implications are cussed, e.g. the existence and nature of complement fragments on the surfaces of the synthesizing proteons L. S.

MINERALOGY 549

549.211 : 548.73 *see Abstr.* 455

GEOPHYSICS 55

550.384.4 : 551.510.535 460

Location of the currents causing the solar and lunar diurnal magnetic variations. MARTYN, D. F. *Nature, Lond.*, **160**, 535–7 (*Oct.* 18, 1947).—The difficulty in assigning diurnal magnetic variations to movements of conducting atmospheric layers has been that the solar variations are sunspot-dependent, and have a lower summer/winter ratio than the lunar; the latter do not appear to correspond to the variations of any of the known layers. Evidence is here reported that both effects are due to the combination of influences of the *D*- and *EF*-layers; the sum in the case of the solar, and the difference in the case of the lunar variation. Thus, for the latter, sunspot variation, being similar in both layers, cancels out; and seasonal changes, being in opposite senses in the two layers, are more noticeable. The increase of lunar variation with increasing magnetic disturbance is also explained, since this is known to produce a greater increase of conductivity in the *D*- than in the *EF*-layer.

551.495 461

Theory of ground-water accumulation. LOWY, H. *Phil. Mag.*, **38**, 79–80 (*Jan.*, 1947).

ATMOSPHERE . METEOROLOGY 551.5

551.508.11 = 4 462

Cellux balloons. BERGER, P. *Arch. Sci. Phys. Nat.*, **29**, 151–204 (*May–June*, 1947) *In French.*—The results of a detailed study of cellux balloons are given, including microscopic examination of its structure, the variations of heating and extension and of bursting strain in saturated and unsaturated air both before and after immersion treatment, and the use of multiple balloons. Cellux balloons possess remarkable qualities down to −85°C and can be made up to a size 220 m³. The greatest difficulties are that they should be released in a calm and their rate of ascent adjusted by variable ballast so that the envelope does not cool too rapidly. With these precautions heights of 20 km should be reached. R. S. R.

551.510.4 : 537.56 : 539.13 463

Distribution of molecular and atomic oxygen in the upper atmosphere. RAKSHIT, H. *Indian J. Phys.*, **21**, 57–68 (*April*, 1947).—An attempt has been made to determine the distribution by adapting the method of studying the distribution of ionization in the earth's atmosphere by the action of solar ultraviolet radiation. The method is essentially the same as that adopted by Majumdar in his analysis [Abstr. 2811 (1938)]. Recent data have been used. It has been found that the density of O_2 molecules decreases very rapidly with height above 100 km. The density of the O atoms, which is almost zero at 80 km, increases rapidly with height, attains a maximum at about 105 km and then gradually decreases. Decre in the density of O atoms at night due to recombinati has also been considered. It is shown that the ato will be in sufficient density at night to emit the gr radiation with the observed intensity.

551.510.535 : 537.564 : 537.122

Rate of electron production in the ionosphere. SEAT S. L. *Phys. Rev.*, **72**, 712–14 (*Oct.* 15, 1947).—Metho are developed for determination of the rate through the 24 hours. Application to experimental data sho that the rate varies more or less systematically from before sunrise to ~800 electrons/cm³sec near no at the equator for an equinoctial interval at sunsp minimum. The results are in general agreement w values determined over restricted time intervals dur eclipse of the sun.

551.510.535 : 537.568 *see Abstr.* 361

551.510.535 : 550.384.4 *see Abstr.* 460

551.510.535 : 621.396.11

The determination of ionospheric electron distributi MANNING, L. A. *Proc. Inst. Radio Engrs, N.Y. W Electrons*, **35**, 1203–7 (*Nov.*, 1947).—The virtual height frequency integral is derived, neglecting absorption a the earth's magnetic field. It is shown how solution this integral equation can be obtained using the Lapl transformation, and how true height *v.* frequency can determined graphically from virtual height *v.* frequen curves. The method is applied to some typical night a daytime ionosphere records.

551.510.535.08 : 621.396.91

An improved ionospheric height recorder. THOM H. A., AND CHALMERS, R. G. *J. Instn Elect. Eng Pt III*, **95**, 7–12 (*Jan.*, 1948).—Automatic equipment described for measuring the virtual height of the reflect regions of the ionosphere. The system comprises a tra mitter, which scans a wide frequency range some times/sec, and a receiver which is tuned slowly throu the same range. Each time the frequency of the tra mitter passes through the pass-band of the receiver pulse is produced which is displayed on an oscillogra together with other pulses produced by waves reflec from the ionosphere. The advantages of this technic are enumerated. The equipment enables a reco covering the range 2–16 Mc/s, to be obtained in a f seconds. The apparatus is fully automatic and produ records as required without manual operation.

551.513.1

Atmospheric oscillations and the resonance theo WEEKES, K., AND WILKES, M. V. *Proc. Roy. Soc. A*, 1 80–99 (*Dec.* 23, 1947).—The circumstances are descril under which tidal energy supplied to the atmosph

ough the action of tide-producing forces can be pped between a certain stratum (usually where the ap. has a min.) and the ground. The results are then plied to discuss in general terms the types of free illation which an atmosphere with a given temp. tribution may possess. Kelvin's hypothesis that the nosphere has a resonance in the neighbourhood of solar hours leads directly to the conclusion that the ap. must fall again to a low value at some level above hot region inferred from observations of the anomalous opagation of sound. Results are given of numerical culations made with a differential analyser to deter- ne to what extent the requirements of the resonance ory restrict the possible temp. variation in the atmo- here. The results of Appleton and Weekes [Abstr. 2654 39)] on lunar tides in the *E* region are discussed, and it shown that there is no difficulty in reconciling them h oscillation theory provided a suitable temp. distribu- n in the *E* region is assumed. A.

551.513.1 = 4 468

Immediate consequences of the emission and absorption heat energy in the atmosphere. CADEZ, M. *Arch. Sci. ys. Nat.*, **29**, 112–18 (*March–April*, 1947) *In French.*— uring gain or loss of heat the sample of air can vary by hange of (1) internal energy or entropy, (2) atmospheric essure, (3) volume. The air immediately surrounding e sample will correspondingly be compressed or panded. This change of energy is called wave or pulse energy. A general result for these transforma- ns is obtained from expressions derived for the three ssible changes in the sample. R. S. R.

551.515.4 : 551.594.6 : 621.396.82 469

Some directional observations of atmospherics on 000 metres during sunset time. KHASTGIR, S. R., DAS UPTA, M. K., AND GANGULI, D. K. *Indian J. Phys.*, **21**, 9–80 (*Aug.*, 1947).—The theory of sunrise and sunset axima in the number and strength of atmospherics is aborated. A simple method is worked out for the cation of a thunderstorm centre which gives rise to mospherics, by observing the time of occurrence of the mospherics maximum, when the distant thunderstorm evails over a length of time covering the time of sunrise sunset. The results of some directional observations of mospherics taken in May–June, 1946, with a cathode-ray be direction-finder are also given in the paper. The sitions of the observed maxima with reference to ground nset enabled determinations of the locations and stances of the thunderstorm centres active during the riod. A.

551.521.12 470

Photoelectric measurements of the seasonal variations in aylight at Plymouth, from 1938 to March 1941, compared th the years 1930 to 1937. ATKINS, W. R. G., AND LLISON, M. A. *Proc. Roy. Soc. A*, **191**, 467–84 (*Dec.*, 947).

551.521.3 471

An estimate of transparency of the atmospheric window 5 mu to 24 mu. ADEL, A. *J. Opt. Soc. Amer.*, **37**, 59–71 (*Oct.*, 1947).—The effective solar radiation tensity, as observed through the atmospheric window tween 16 μ and 24 μ, is determined by comparison with e observed radiation intensity of the earth's surface hermocouple) below 13 μ. The ratio of the effective alue to the value calculated for $T = 6\,000°K$ is the ansparency of the atmosphere to solar radiation within e interval. Opacity in this spectral region is due rgely to water vapour and CO_2. Provisional estimates f transmission are given. The net loss of energy by the arth's surface through the window is small, but probably ot negligible from a meteorological point of view. A.

551.521.3 : 535.436 : 518.2 472

The primary and secondary scattering of sunlight in a plane-stratified atmosphere of uniform composition. III. Numerical tables and discussion of secondary scattered light. HAMMAD, A. *Phil. Mag.*, **38**, 515–29 (*July*, 1947).— A continuation of previous work [Abstr. 1409 (1946)]. The directional distribution of the secondary scattered light emitted from any point in the atmosphere is discussed and calculations of its deviation from complete isotropy are made. The scattered light received at the ground from different directions is also estimated. Tables are given of the function,

$$\int_1^\infty e^{-xu} u^{-n} du,$$

for $n = 1, 2, 3, 4, 5$ and $x = 0{\cdot}00(0{\cdot}01)1{\cdot}00$. The emission of secondary scattered light is much more nearly isotropic than that for the primary, especially for radiation with high attenuation coefficient. If this coefficient is small the contribution of secondary scattering to the scattered light at the ground is small compared with that of the primary, especially for high solar latitudes and high directions of observation. L. S. G.

551.524.7 : 551.557 473

Relationship between wind velocity and temperature in the free atmosphere. BANERJI, S. K. *Indian J. Phys.*, **21**, 50–6 (*April*, 1947).—Formulae are given for the computation of upper air temperature from the known distribution of velocities of upper winds as given by pilot balloon observations. Shaw's formulae hold only when geostrophic conditions are satisfied, and are not applicable to tropical regions. A closer approximation is obtained by the use of the formulae. A.

551.553.22 : 551.58 = 3 474

Remarks on K. Frey's Föhn theory. KUHN, W. *Experientia*, **3** (*No.* 10) 423–4 (*Oct.*, 1947) *In German.*— Criticism [see Abstr. 3385 (1947)].

551.557 : 551.524.7 *see Abstr.* 473

551.571.4 : 621.396.11 475

Psychometric observations in the lower atmosphere. CRAIG, R. A. *Papers in Physical Oceanography and Meteorology*, **10** (*No.* 1) (*Nov.*, 1946). *Nature, Lond.*, **160**, 546 (*Oct.* 18, 1947).—A discussion of nearly 500 observations in the lowest 1 000 ft of the atmosphere, made in connection with studies on the propagation of centimetre radio-waves near the sea surface.

551.577 = 4 476

Artificial formation of rain. BRUN, E., AND DEMON, L. *C.R. Acad. Sci., Paris*, **225**, 505–6 (*Sept.* 22, 1947) *In French.*—The phenomenon of coalescence was examined on an artificial fog. Left alone the fog disappears in about 20 minutes, but the addition of 0·1 cc of solid CO_2 to 6 m^3 of fog increases the opacity in 1 min, scintillations due to ice crystals occur in 2–3 min, and in the 5th min the fog clears with snow flakes having fallen. This could be applied on a large scale. Findersen's theory is used to give an explanation. R. S. R.

551.58 : 551.553.22 = 3 *see Abstr.* 474

551.594.2(494) = 3 477

New results of lightning studies in Switzerland. BERGER, K. *Bull. Ass. Suisse Élect.*, **38**, 813–23 (*Dec.* 13, 1947) *In German.*—Further additions to the measuring equipment installed on Mount San Salvatore [Abstr. 2322 (1946)] are described. Oscillographic results of lightning currents recorded during 1946, including a large proportion of positive currents, are presented and discussed. From these results, frequency distribution curves are produced of the number of component strokes in lightning flashes, the duration of flashes and strokes, the charges in

flashes and strokes, and the current values measured. The mechanism of the lightning discharge in the extreme cases of strokes to open country and to extremely tall structures is outlined, and the lightning conductor installation on Mount San Salvatore is shown to represent somewhat an intermediate position between the two above extremes. R. H. G.

551.594.221 478

Progressive lightning. VII. Directly-correlated photographic and electrical studies of lightning from near thunderstorms. MALAN, D. J., AND SCHONLAND, B. F. J. *Proc. Roy. Soc. A*, **191**, 485–503 (*Dec.*, 1947).—An analysis has been made of the direct correlation of luminous and electrical field-changes produced by 37 lightning discharges to ground. These discharges comprised 199 separate strokes, most of which were within a distance of 6 km. A new form of drum camera and a camera shutter operated by the first leader were employed, and many records were obtained in daylight. When compared with results previously reported for flashes at distances of 10 km or more, the following major differences are found: negative field-changes from near leaders; absence of electrical effects of first leader steps and hook-shaped field-changes during the period immediately following the return stroke. The hook field-changes are shown to be associated with components in the continuing luminosity of the channel of the type investigated by Malan and Collens [Abstr. 4447 (1937)] and to be due to subsidiary discharges in this channel. These "*M*" components carry negative charge to ground in quantities between $\frac{1}{5}$ and $\frac{1}{100}$ of those carried by main strokes. The height of the lower negative charge in these thunder-clouds is found to be from 4 to 9 km. During a discharge to ground, no rapid discharges occur within the cloud or elsewhere than in the cloud-ground channel. A fairly slow discharge of the upper positive charge in the thunder-cloud appears to occur to the upper air immediately after the lower negative pole has discharged to ground.

551.594.6 : 621.396.82 : 551.515.4 *see Abstr.* 469

551.596.1 : 534.22 = 5 *see Abstr.* 263

BIOLOGY 57/59

576.8 : 535.24 = 4 *see Abstr.* 76

578.087.86 : 536.532 479

Studies of thermal injury. VIII. Automatic recording caloric applicator and skin-tissue and skin-surface thermocouples. HENRIQUES, F. C., JR. *Rev. Sci. Instrum.*, **18**, 673–80 (*Sept.*, 1947).—The apparatus enables the skin surface to be brought immediately to and maintained at a constant, predetermined temperature, and it continuously records the rate of the perpendicular flow of heat through this skin site during the entire heat exposure. A.

578.088.5 : 539.16 : 541.141 *see Abstr.* 444

581.035 : 541.144.7 *see Abstr.* 445

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612.53 : 536.2 480

Some physical aspects of the heat balance of the human body. BRUNT, D. *Proc. Phys. Soc., Lond.*, **59**, 713–26 (*Sept.*, 1947).—Presidential address. Some of the more important reactions of the body to its environment are summarized. The relationship of radiation, convection, and evaporation, to environmental conditions, and the limiting conditions for heat stroke, for nude subjects, are discussed. The general effects of temperature and humidity are considered, and a comparison made with natural climates. S. W.

612.82 : 621.396.645.3 481

Electro-encephalograph amplifier. HARRIS, E. J., AND BISHOP, P. O. *Wireless Engr*, **24**, 375 (*Dec.*, 1947).—[Abstr. 389 B (1948)].

612.843.31 482

Some fatigue effects on the human retina produced by using coloured lights. HARTRIDGE, H. *Nature, Lond.*, **160**, 538–9 (*Oct.* 18, 1947).

612.85 = 5 483

Sensitivity to bi-auricular location as function of frequency. BOLLE, A., LO SURDO, A., AND ZANOTELLI, G. *Ric. Sci. Ricostruz.*, **17**, 873–7 (*June*, 1947) *In Italian.*—Using apparatus previously described [Abstr. 3760 (1947)] in connection with determination of the threshold displacement value as dependent on intensity and phase at frequencies of 128, 256, 512 and 1 024 c/s, experiments were made up to 4 000 c/s. The intensity threshold value remains nearly const. between 128 and 1 000 c/s, the phase threshold increases with frequency, and for frequencies nearing 4 000 c/s the values of both phase and intensity threshold decrease slightly. J. A. W.

612.85: 534.771 = 3 *see Abstr.* 273

615.849.1 48

Comparative value of deep and super-voltage roentgen therapy. LEUCUTIA, T. *Amer. J. Roentgenol. Radium Ther.*, **58**, 347–56 (*Sept.*, 1947).—Clinical results of treatment of cancer of varying types, with 200 and 500 kV excited X-ray tubes, are given. Theoretical and physical considerations have been found to be substantiated. Supervoltages are less injurious to the skin and superficial tissues, but there is no evidence of any dependence of results upon the quality of radiation and, therefore, voltage excitation values. Supervoltage irradiation is considered of noteworthy value in selected cases. B. J. I.

616–073.75 : 620.179.15 : 537.531 : 778.33 *see Abstr.* 209

616–073.75 : 621.386.1 : 389.6 48

The standardization of roentgenographic tubes and high voltage cables. MORGAN, R. H. *Amer. J. Roentgenol. Radium Ther.*, **58**, 342–6 (*Sept.*, 1947).—A summary of the advantages of standardization. B. J. I.

616–073.75 : 778.33 48

Roentgen tube potentials in diagnostic roentgenology. MORGAN, R. H. *Amer. J. Roentgenol. Radium Ther.*, **58**, 211–21 (*Aug.*, 1947).—The present paper deals with research to determine effect of voltage on (*a*) quality of radiation in radiographic and radioscopic procedures; (*b*) efficiency of X-ray production; (*c*) dosage received by the patient during radioscopy. It is found that increased voltage offers no advantages in respect of image detail or dosage received by the patient during screen procedures. In chest mass radiography procedures there would appear to be advantages, but it is questionable whether these warrant the extra expense of the special apparatus. B. J. I.

METALLURGY 669

669.215.3 : 536.413 : 548.73 *see Abstr.* 454

669.215.3 : 548.736.34 *see Abstr.* 457–8

[669.24 + 669.25] : 536.421.4 + 535.233 *see Abstr.* 316

[669.25 + 669.24] : 536.421.4 + 535.233 *see Abstr.* 316